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Mariners Weather Log

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ENVIRONMENTAL DATA AND INFORMATION SERVICE.
Thomas D. Potter, Acting Director

Cover: High waves from hurricane David lash at the shore and lighthouse at Hillsboro Inlet near Fort Lauderdale, Fla., on September 3. A preliminary report on David appears on page 322. Wide World Photo.

Back Cover: This 30-ft sailboat was blown against a house as hurricane Frederic lashed the Gulf Coast on September 12. He struck the same area devastated by Camille 10 yr ago. Wide World Photo.

ARTICLES
297 Manila as a typhoon haven
306 Western North Pacific typhoons, 1978

HINTS TO THE OBSERVER
320 Preliminary report on weather messages received from U.S. cooperating ships

TIPS TO THE RADIO OFFICER
321 Reports of wind and sea conditions wanted
321 Gulf of Mexico oil spill message
321 HF-SSB from Coast Guard Radio Station Guam
321 Corrections to Worldwide Marine Weather Broadcasts (January 1979 Edition)

HURRICANE ALLEY
322 Hurricane David--A preliminary report
325 Southern Hemisphere - May and June 1979
325 Addition to South Indian Ocean - April 1979
325 North Indian Ocean - May and June 1979

ON THE EDITOR'S DESK
326 Vessel traffic service recommended for Chesapeake Bay entrance
328 Hurricane Camille struck 10 yr ago
328 Tidal wave levels four Indonesian villages
329 St. Lawrence Seaway closing
329 YELLOWSTONE - IBN BATOUTA collision evaluation
329 Waterspout
329 Bad winter for insurers
330 Fishing vessel ABUNDANCE burns
330 NOAA tests device as oil-spill detector
331 NOAA-6 launched
332 Letters to the Editor, Certificate of membership presentation

MARINE WEATHER REVIEW
333 Smooth Log, North Atlantic Weather, March and April 1979
339 Smooth Log, North Pacific Weather, March and April 1979
344 Principal tracks of centers of cyclones at sea level, North Atlantic, March 1979
345 Principal tracks of centers of cyclones at sea level, North Atlantic, April 1979
346 Principal tracks of centers of cyclones at sea level, North Pacific, March 1979
347 Principal tracks of centers of cyclones at sea level, North Pacific, April 1979
348 U.S. Ocean Buoy climatological data, March and April 1979
351 Selected gale and wave observations, North Atlantic, March and April 1979
352 Selected gale and wave observations, North Pacific, March and April 1979
355 U.S. Cooperative Ship weather reports, March and April 1979
357 Rough Log, North Atlantic Weather, June and July 1979
365 Rough Log, North Pacific Weather, June and July 1979

MARINE WEATHER DIARY
371 North Atlantic, October
371 North Pacific, October
372 North Atlantic, November
373 North Pacific, November

Mariners Weather Log

Editor: Elwyn E. Wilson
Editorial Assistant: Annette Farrall

November 1978
Volume 22 Number 6
Washington, D.C.

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The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget through June 30, 1980.

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Mariners Weather Log

MANILA AS A TYPHOON HAVEN

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Editor's Note: This is the fifth in a series of articles evaluating the safety of ports as shelters from tropical cyclones. These are edited versions of studies that appear in the Typhoon Havens Handbook for the Western Pacific and Indian Oceans by Samson Brand and Jack W. Blelloch, June 1976, Naval Environmental Prediction Research Facility, Monterey, Calif.

Manila Bay has had a reputation for sheltering sailing vessels from the seas of tropical cyclones since its discovery by early sailors. However, the effects of typhoon Patsy in November 1970 and typhoon Ora in June 1972 have irreparably damaged that reputation (fig. 1a).

During Patsy, which passed over Manila, high winds and seas sank 21 fishing boats near the North Harbor. Larger vessels dragged anchor or broke loose. Six of them were driven aground or smashed against Roxas Boulevard (fig. 1b). Ora repeated this tragedy a few years later, when another six oceangoing vessels were swept into the breakwater.

It is the conclusion of this study that Manila Harbor

FIGURE 1b

Figure 1.--These ships did not find a safe refuge in Manila Bay. (a) The strong winds of typhoon Patsy (1970) drove the PMI ENGINEER hard aground on the Manila seawall; and (b) the same seawall claims the Singapore freighter SHUN HING after typhoon Ora (1972) hit the harbor.

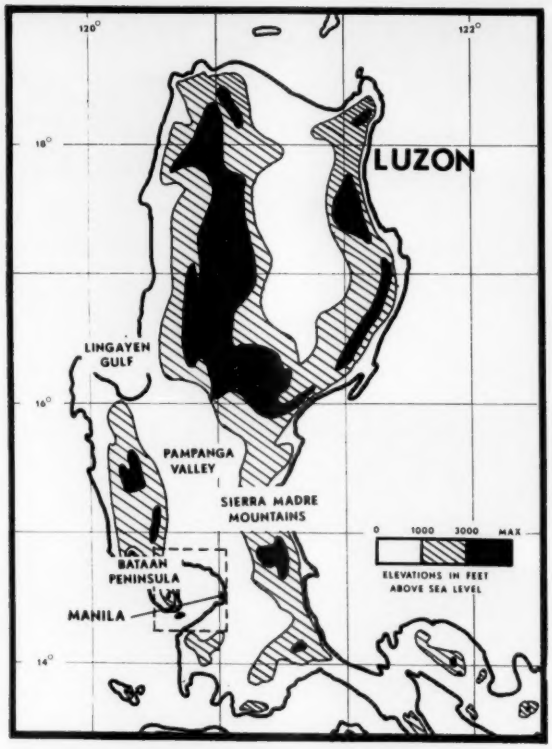


Figure 2.--Topographical map of Luzon showing approximate elevation above sea level and the location of Manila. The area within dotted outline is expanded and presented in figure 3.

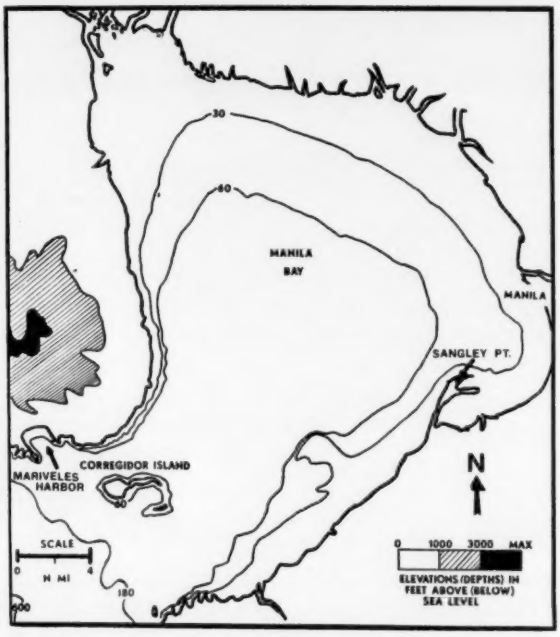


Figure 3.--Depth contours, Manila Bay (ft).

is not a safe harbor and Manila Bay is not a safe refuge during a passage of a typhoon. The policy of the Port Captain of the South Harbor, Manila, is to evacuate all vessels at least 24 hr prior to typhoon passage. The harbor is congested with merchant and commercial shipping vessels. The vessels are, more often than not, equipped with inadequate mooring equipment, and they may evacuate to any area in Manila Bay outside the confines of South Harbor. Because of the danger of ships breaking loose from anchor during the storm and the shallowness of the bay, evasion is recommended from both the harbor and the bay.

THE SETTING

Manila is the largest city in the Philippine Islands and is located on the eastern shore of Manila Bay (fig. 2). Manila Bay is approximately 26 mi long, 19 mi wide at its widest point, and includes an area of about 550 mi^2. The entrance is divided into the North and South Channels by Corregidor and Caballo Islands. Both are deep and clear of obstructions. The Sierra Madre mountains to the east and the mountains of the Bataan Peninsula help to shelter Manila Bay from severe winds.

The depths of Manila Bay range from over 180 ft in the entrance to about 90 ft in the center, decreasing gradually to the shore (fig. 3). The bay is also very shallow in some places and has relatively poor holding

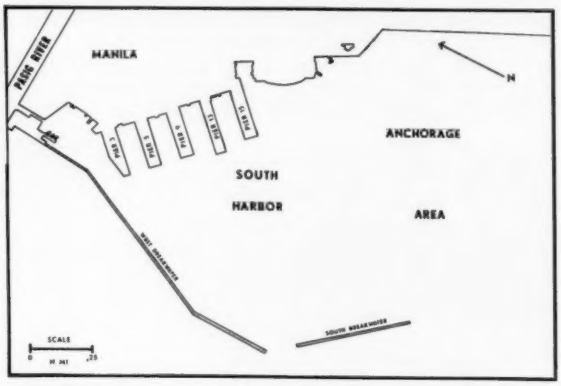


Figure 4.--Manila Harbor plan showing the location of piers and anchorage areas.

action due to its sand and soft mud bottom.

The port of Manila consists of the North and South Harbors, both of which are protected by breakwaters. The Pasig River separates the two harbors and is navigable to a distance of 1 mi from its mouth by small vessels drawing up to 10 ft. The North Harbor is the smaller of the two harbors and is used solely for interisland shipping. The South Harbor is used for large oceangoing vessels and is the harbor that will be considered in this study (fig. 4).

There are five odd-numbered piers that extend southeastward from the northern side of South Harbor. These piers contain the principal deep-draft berths and range in depth from 9 to 36 ft. There are anchorages, both inside and outside the breakwater, for an

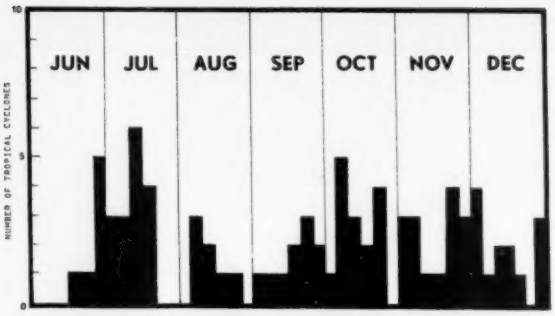


Figure 5.--Frequency distribution of the number of tropical cyclones that passed within 180 mi of the midpoint connecting Manila Harbor and Port Olongapo. Subtotals are based on 5-day periods for tropical cyclones that occurred during 1955-1973.

unlimited number of vessels of all classes. The anchorages range in depth from 8 to 22 fathoms with less than adequate holding ground.

THE CLIMATOLOGY

Although tropical cyclones can occur at any time of year, the majority of those which threaten Manila occur from June through December. Figure 5 depicts the monthly summary by 5-day periods of tropical cyclone occurrences based on data for the 19 yr, 1955-1973. Of the 83 tropical cyclones that threatened Manila, the peak threat periods exist in July, October, and November, but a consistent threat exists throughout the June to December period. This is an average of more than four storms each year; the largest number in a single year has been eleven.

For the purposes of this study, the midpoint of a line connecting Manila Harbor and Port Olongapo was used. This point is the center of a 180-mi circle used to determine whether or not a tropical cyclone represents a threat (any tropical cyclone approaching within 180 mi of this point is considered a threat) to the ports of Manila and Subic Bay. (It will be referred to simply as Manila.)

Figure 6 displays the above storms as a function of the compass octant from which they approached Manila. The numbers indicate the number of storms approaching from that octant, while the numbers in parentheses indicate the percentage of storms approaching from that octant. It is evident that the majority of storms approach from the east-southeast.

Figures 7 to 13 present the percentage of tropical cyclones that have passed within 180 mi of Manila (can be interpreted as the probability of threat) for the months of June to December, respectively. The solid lines represent the "percent threat" for any storm location. The dashed lines represent approximate approach times to point X based on an approach speed of

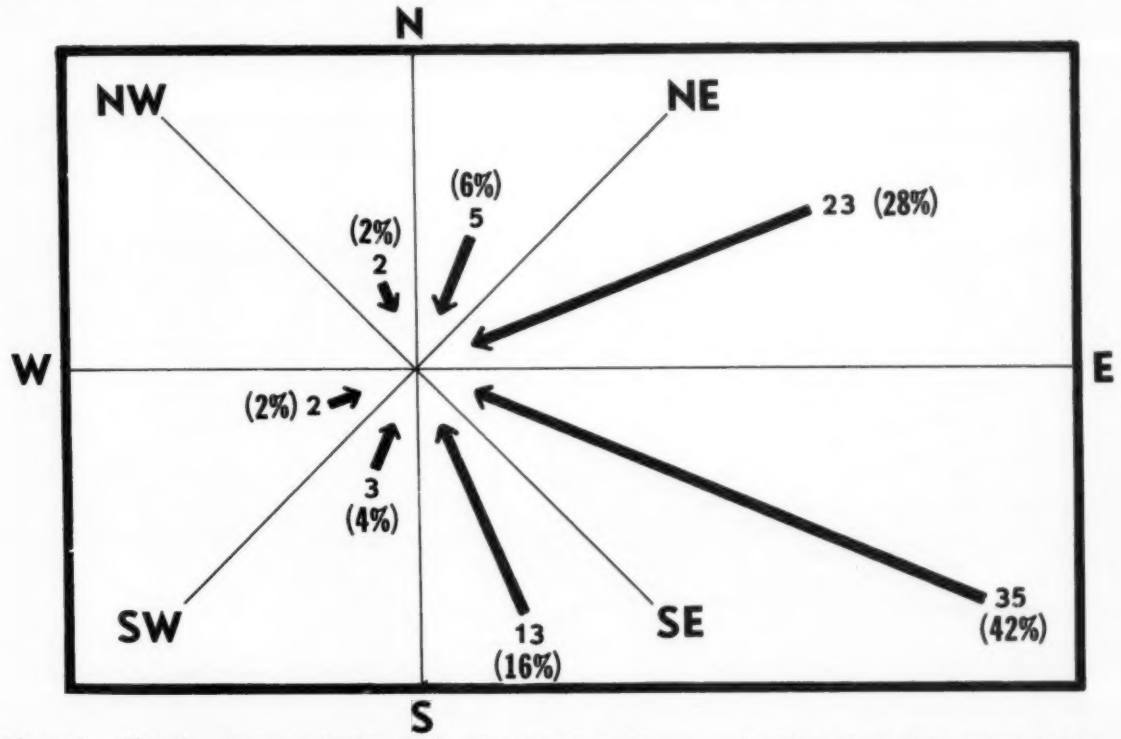


Figure 6.--Direction of approach of tropical cyclones (1955-73) that passed within 180 mi of the midpoint noted in figure 5. Numbers indicate the number that approached from each octant. Number in parentheses is the percentage of the total sample (83) that approached from that octant.

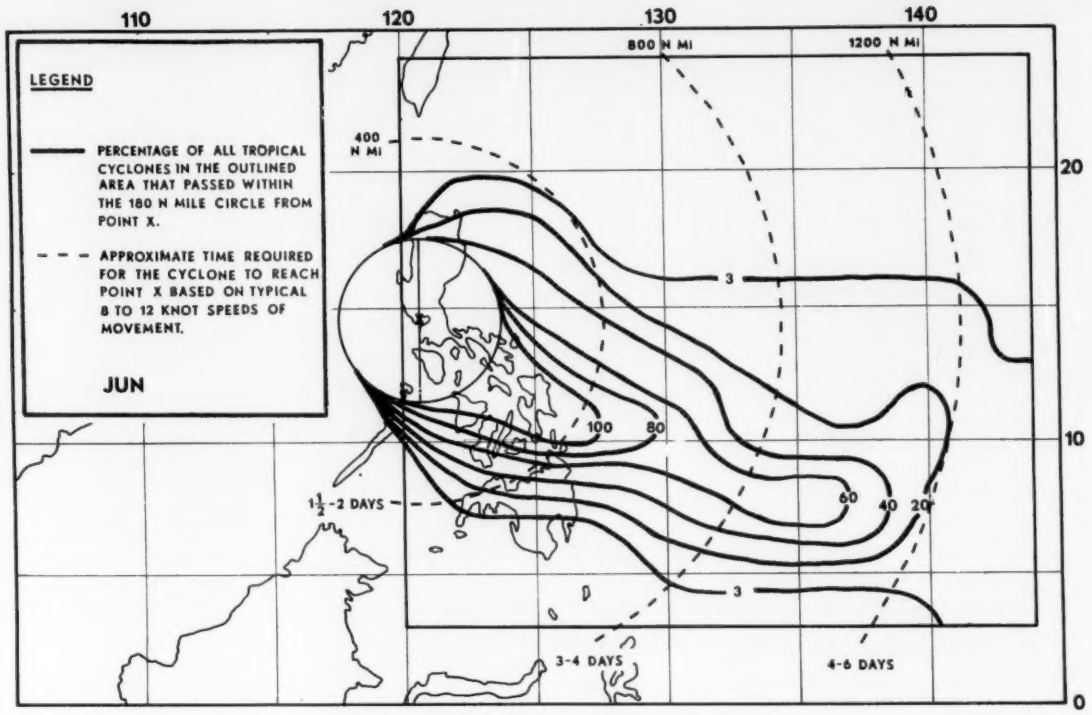


Figure 7.--June probability of threat.

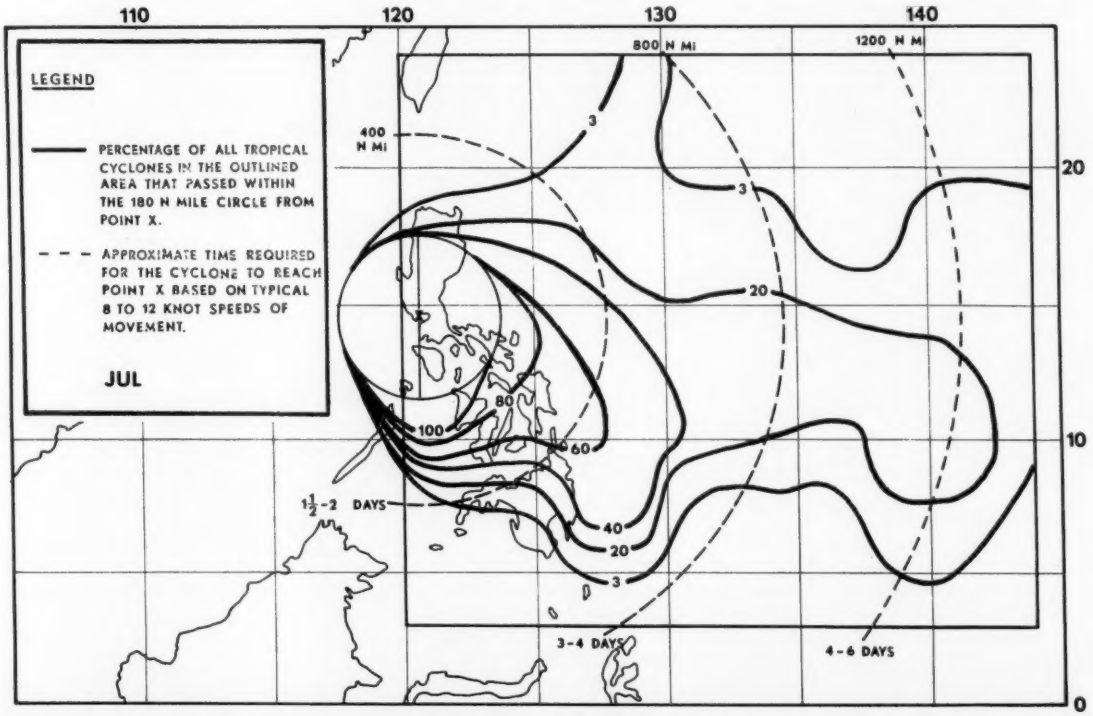


Figure 8.--July probability of threat.

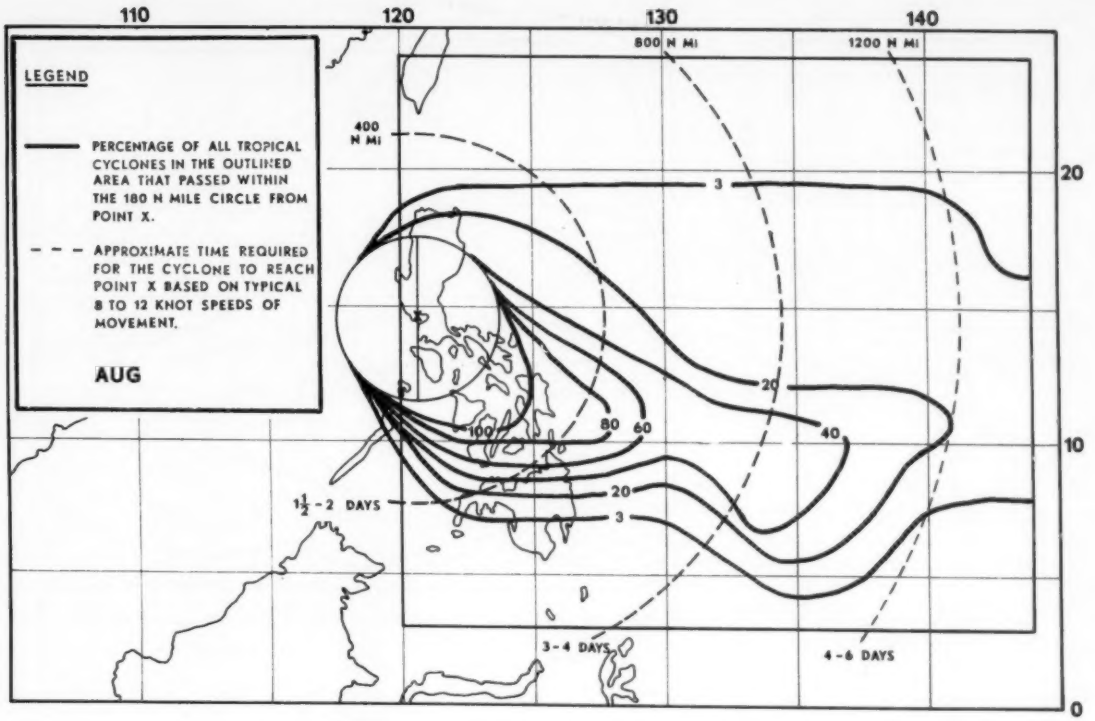


Figure 9.--August probability of threat.

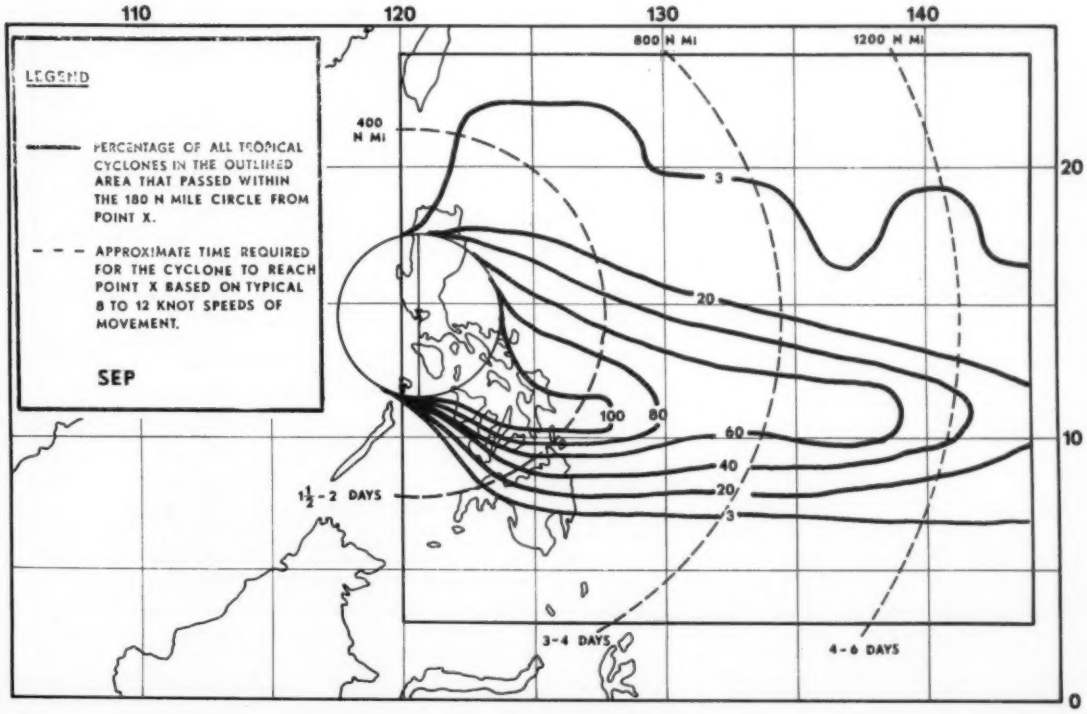


Figure 10.--September probability of threat.

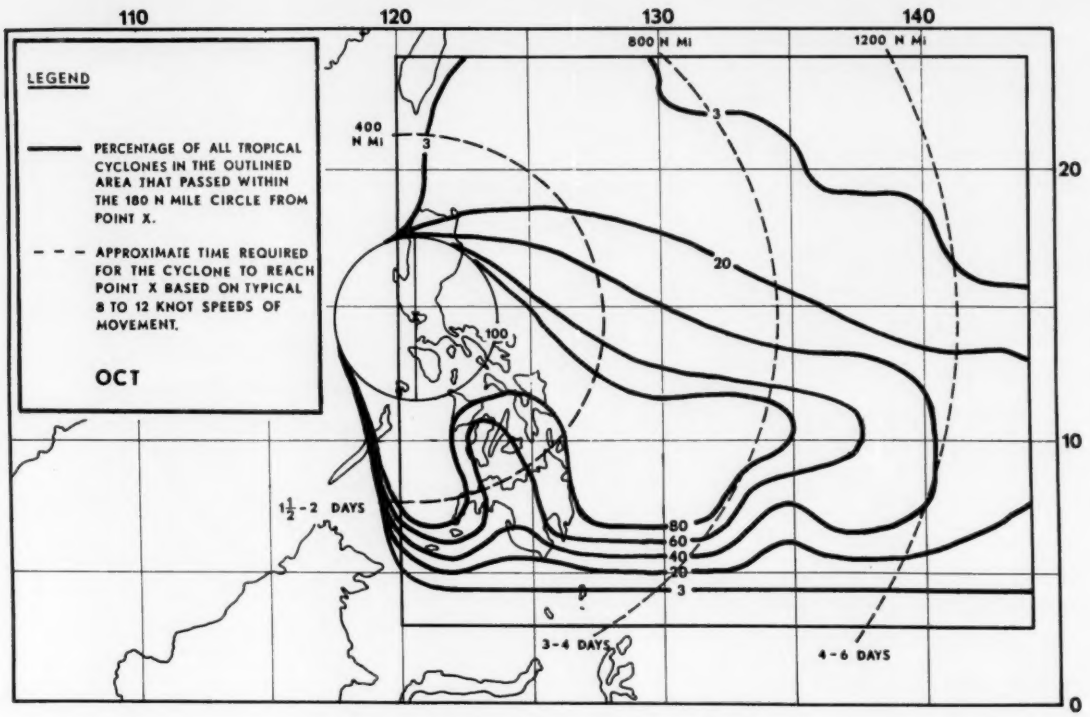


Figure 11.--October probability of threat.

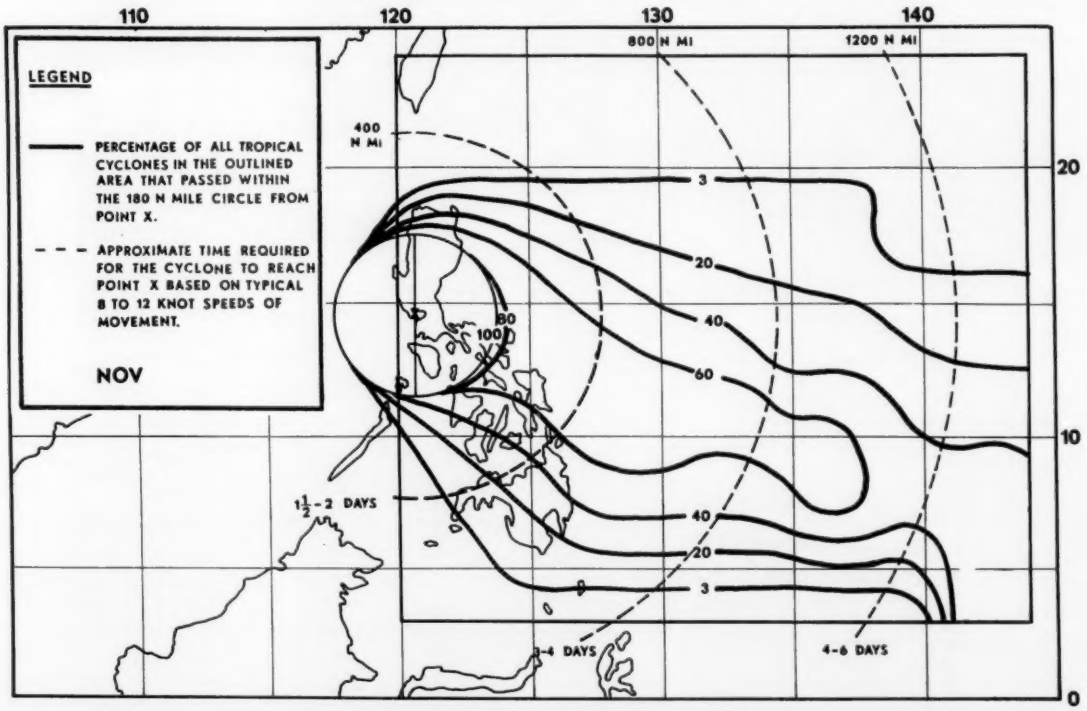


Figure 12.--November probability of threat.

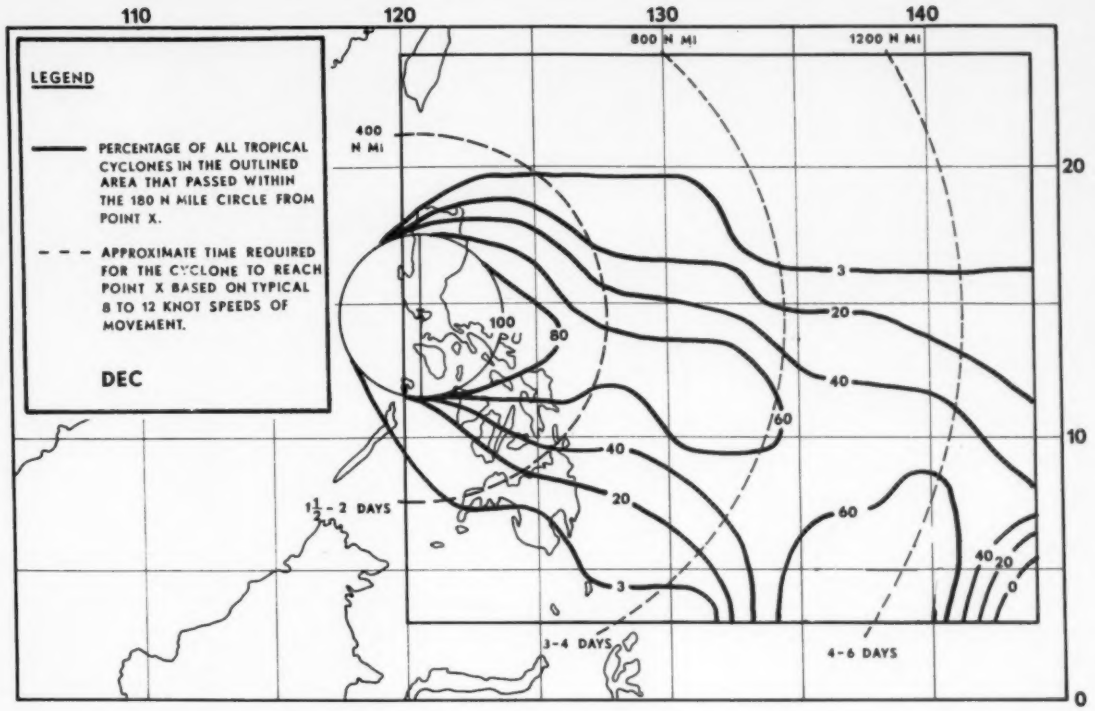


Figure 13.--December probability of threat.

8 to 12 kn. For example, in figure 7, a storm located at 130°E, 10°N, has between a 60- and 80-precent probability of passing within 180 mi of Manila, and it will reach the port in approximately 2-1/2 days, if its speed remains between 8 to 12 kn.

Of the 83 tropical cyclones, 24 resulted in strong winds ($\geq$ 22 kn) at Manila, but only 7 resulted in gale-force winds there ($\geq$ 34 kn). The wind data for Manila is from Sangley Point for the years 1955-1968. From 1969-1973, the data were taken from a wind gage at the mouth of the Pasig River and have been verified to be representative of the wind in Manila Bay. It should be noted the above wind data are reduced from hourly wind observations. There are situations, of course, in which a high maximum sustained wind was observed for a short period of time between hourly observations and would not be included.

It is apparent that Manila is a sheltered harbor. The Sierra Madre mountains to the east and the Bataan Peninsula to the west effectively serve as a wind barrier. When gale-force winds do appear, they are generally funneled from the Lingayen Gulf through the Pampanga Valley to Manila.

The relatively few tropical cyclones that result in gale-force winds at Manila begin affecting the port very close to, or after, tropical-cyclone passage (fig. 14). Those tropical cyclones resulting in strong winds ($\geq$ 22 kn) have not affected Manila until the cyclone centers were very close to the east coast of the Philippines, but tropical cyclones several hundred miles to the west of the Philippines still had an effect on the winds experienced there (fig. 15).

Information on wave heights for Manila Harbor or

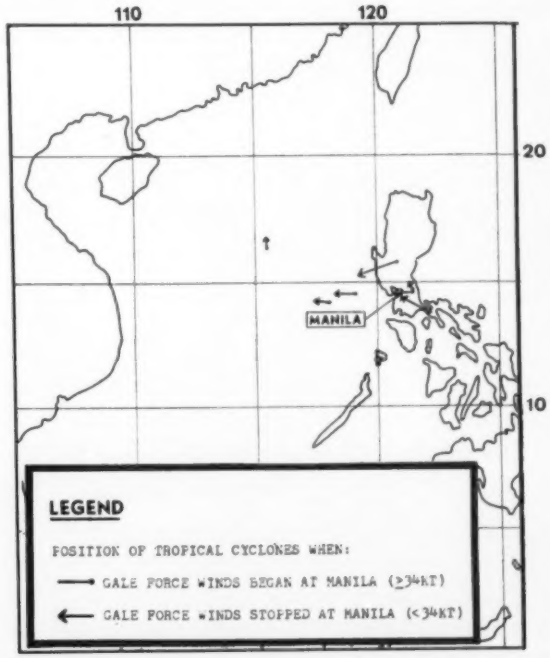


Figure 14.--Position of tropical-cyclone centers when $\geq$ 34-kn winds first and last occurred at Manila (based on data from 1955-73).

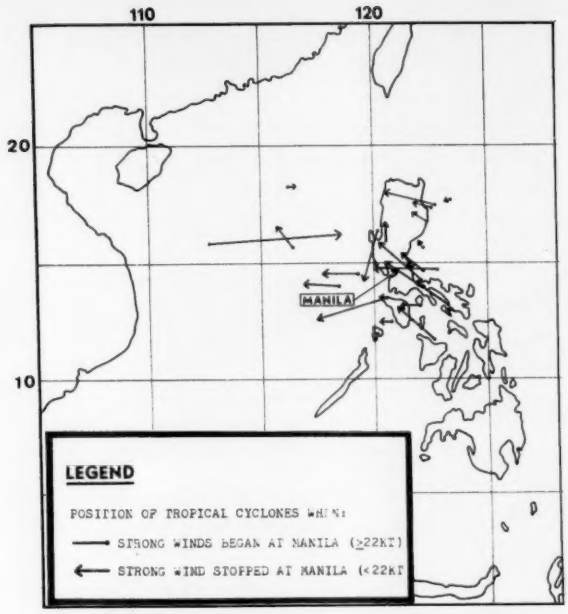


Figure 15.--Position of tropical-cyclone centers when ≥ 22-kn winds first and last occurred at Manila (based on data from 1955-73).

Manila Bay is not readily available. However, strongest winds are experienced in the bay when a typhoon is near or over the Lingayen Gulf and funneling winds occur through the Pampanga Valley to Manila. These strong north-northwesterly winds present more of a hazard to ships in the bay than do the waves they generate. Owing to the relatively short fetch and shallow bottom, the generated waves could reach 10 ft or more in significant height but should not build to excessively high levels.

The swell coming into the bay is damped considerably by Corregidor Island which sits in the mouth of the bay. It serves to split the swell and deflect it to either side. The possibility of shoaling (the building in magnitude of waves when the water depth reaches one-half their wavelength) occurs when the deflected swell reaches the shallower portions of the bay.

During October 1978 typhoon Rita passed about 60 mi north of Manila while the MAYAGUEZ was anchored in Manila Bay. She was weakening rapidly at the time, but the ship's log relates an interesting sequence of events (fig. 16).

THE DECISION

Remaining in port when it is possible to evade a storm is a decision that is contrary to most of the traditional rules of seamanship. However, if the decision to remain in port is made, it should not be done without considering every available fact concerning the impending storm and the port in which the vessel is berthed. In the case of Manila Harbor, the following should be noted:

1. Securing to a pier or anchoring in Manila Bay should be done prior to the onset of 22-kn winds to prevent undue difficulty in mooring.

Mariner Weather Log
US Dept. of Commerce
National Oceanic & Atmospheric Adm.
Environmental Data Service
Washington D.C. 20235
Attn: Elwyn E. Wilson, Editor

S.S. Mayaguez Voyage 406
Kaohsiung, Taiwan
October 31, 1978

Re: Typhoon Rita passing Manila
October 27, 1978

This vessel was anchored in the middle of Manila Bay during this typhoon Rita. Lat. 14-36 N., Lo. 120-47 E.

For your information, the weather data from our deck log and the baragraph chart are enclosed.

Very truly yours,

Stanley Maleski

Stanley Maleski, Master

26 October 1978 2D -8

LOCAL TIME	SKY	WIND DIRECTION	WIND FORCE	VISIBILITY	BAROMETER	TEMP. AIR
0200	CLEAR	NNW	2	98	29.99	80/77
0400	CLEAR	NNW	2	98	29.62	80/77
0600	PT CLOUDY 8°CAST	NNW	3-4	98	29.64	78/76
0800	LT RAIN CLOUDY	NE	4	96-97	29.72	78/75
1000	LT RAIN CLOUDY	NE	3	97	29.69	84/77
1200	O'CAST	WSW	3	97	29.59	84/78
1400	O'CAST	WNW	2	97	29.51	86/78
1600	O'CAST	LT. VARIA		96	29.48	83/79
1800	SHOWERS CLOUDY	NW	4	98	29.42	83/77
2000	SHOWERS CLOUDY O'CAST	NW	5	97	29.40	83/76
2200	LT. RAIN O'CAST	NW	6-7	98	29.32	84/78
2400	LT. RAIN O'CAST	WNW	8	98	29.33	80/78
		27 October 1978				
0200	HEAVY RAIN	SW	8	94	29.20	80/79
0300	HEAVY RAIN	SW	9	91	29.27	
0400	HEAVY RAIN	SSW	9	92	29.32	
0600	HEAVY RAIN	SW	8	94-95	29.42	
0700	HEAVY RAIN	SSW	8	95	29.48	
0800	LT. RAIN O'CAST	SW	7-8	85-96	29.57	78/76
0900	LT. RAIN O'CAST	SW	5-6	95	29.54	
1000	LT RAIN O'CAST	SSE	4-5	96	29.60	
1200	LT. RAIN	SSE	4	96	29.60	
1400	LT.-HEAVY RAIN	SE	5	95	29.54	
1600	O'CAST-RAIN	SE	4	98	29.60	77/74
1800	O'CAST	ESE	3-4	98	29.64	77/76
2000	PT CLOUDY	SE	3-3	98	29.68	78/77
2200	PT CLOUDY	SE	3	99	29.70	80/78
24 00	PT CLOUDY	SE	2	99	29.70	80/78

Typhoon Rita passed about 60 miles north of Manila, P.I.

S.S. MAYAGUEZ
OFF. NO. 245646
SEA-LAND SERVICE, INC.

Figure 16.--Hourly weather, typhoon Rita, Manila Bay.

2. No berths in Manila Harbor can be considered totally sheltered.

3. Manila Bay is extremely shallow in places and has relatively poor holding ground, since the bottom consists of soft mud and sand.

4. Mariveles Harbor is the most secure harbor in times of weather stress, but it is only large enough to accommodate two or three ships safely.

5. South Harbor in Manila Harbor is crowded and at any given time can contain many merchant ships. Some of these vessels may be equipped with inadequate or poorly maintained mooring gear. As a result, it is not uncommon for them to break loose and cause damage to other ships in port.

When evasion of a tropical cyclone is being considered, the importance of correctly assessing the threat posed by the storm and acting quickly so as to retain flexibility cannot be overemphasized. The following timetable, depicted in figure 17, has been constructed for this purpose:

1. There is an existing tropical cyclone, or potential development, in Area C with movement forecast

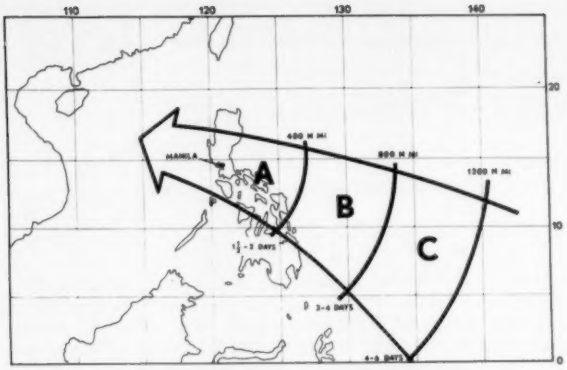


Figure 17.--Tropical cyclone threat axis for Manila. Distances and approach times are measured from Manila, based on an 8- to 12-kn speed of movement.

toward Manila:

a. Review the material condition of the ship; sailing within 2 to 4 days is a distinct possibility.

b. Reconsider all maintenance activities scheduled to exceed 48 hr.

2. A tropical cyclone has entered Area B with movement forecast toward Manila:

a. Operational plans should be made in the event of evasion.

b. Reconsider all maintenance activities scheduled to exceed 24 hr.

3. A tropical cyclone has entered Area A with movement forecast toward Manila:

a. Execute evasion plans made in previous steps.

THE EVASION

One of the more successful Pacific Ocean evasion tactics involves running downwind and downsea relative to the tropical cyclone in order to reach a latitude south of the storm and in the navigable semicircle. The success of this method requires almost continuous reconnaissance coverage along with the relatively slow movement and gradual expansion of the initially small area affected by severe winds that is characteristic of typhoons at low latitudes.

For a ship in or near Manila, the following evasion techniques for the more common threat (any tropical cyclone expected to have a CPA within 180 mi) situations are suggested.

1. Tropical cyclone forecast to pass north of Manila:

Evasion should be to the west-southwest since ship already in the navigable semicircle and will remain there.

2. Tropical cyclone forecast to pass east of Manila:

Evasion should be to the west-southwest since an eastward-passing tropical cyclone may have already started recurvature, and a westward heading will keep the ship in the navigable semicircle.

3. Tropical cyclone forecast to pass south of Manila:

Evasion should be to the west-southwest. This decision should be made as early as possible to preclude a rendezvous with the storm.

It should be noted that some tropical cyclones do generate in the South China Sea each year. However, their normal tracks are to the west and/or north and should not present a threat in the Manila area.

In all cases, careful monitoring of the storm should be conducted to permit the proper evasion technique to be employed in the event of a sudden, unpredicted change in the track by the storm.

Whatever evasion decision is made, the following general comments should be considered.

1. Even weak typhoons crossing the Philippine Islands can quickly result in strong winds in Manila Bay. The decision to evade should be made far enough in advance to preclude difficulties in exiting Manila Bay.

2. Crossing ahead of a typhoon should be accomplished well in advance of the approaching typhoon. Heavy swells may be encountered ahead of the advancing typhoon considerably before the occurrence of strong winds. Such swells may decrease a ship's maneuverability and speed of advance, preventing clearance of the typhoon track.

3. At certain times of the year, particularly the peak typhoon season, the possibility exists that two or more tropical storms are present. This would greatly complicate any evasion planning and execution.

4. A looping tropical cyclone can cause a false sense of security as evaded ships attempt to return. A looping storm in the South China Sea after initial passage can regenerate and cause as high or higher winds and seas upon its return.

WESTERN NORTH PACIFIC TYPHOONS, 1978

Extracted from Annual Typhoon Report, 1978, U.S. Fleet Weather Central, Joint Typhoon Warning Center, Guam, Mariana Islands.

The western North Pacific experienced a near-climatological average number of tropical cyclones with 32 during 1978 (table 1). Cyclones 10 and 30 occurred in the central North Pacific area. Four significant tropical cyclones never developed beyond the tropical-depression stage. Of the 28 that became tropical storms, 15 developed to typhoon stage, and one of these reached the 130-kn intensity necessary to be classified as a supertyphoon.

Even though the 1978 season had a near-average number of cyclones (tables 2 and 3), it was a season full of surprises. Ten of the tropical storms and typhoons exhibited erratic movement. Typhoon Carmen remained quasi-stationary for 3 days over the East China Sea. Typhoon Faye executed a large anticyclonic loop and subsequently underwent explosive deepening as the surface central pressure fell 18 mb in 6 hr. The most ill-behaved typhoon of the season, Trix, truly lived up to her name. As tropical storm Kit crossed Luzon, the surface circulation dissipated, while the mid-level and upper level circulations continued across and eventually became alined with a secondary or "lee-side" LOW that had formed west of Luzon. Tropical storms Hester and Phyllis attained postrecurvature speeds of 40 kn and 50 kn, respectively, in extratropical transition. Typhoons Virginia and Mamie were unusually compact and thus could be termed midget typhoons. Virginia also traveled the farthest north (42°N) while retaining tropical characteristics. Supertyphoon Rita was first detected in the central Pacific near 175°W. She traveled a record distance for the season (4,142 mi), second overall only to typhoon Sarah of 1976 (4,499 mi).

During 1978, 32 Tropical Cyclone Formation Alerts were issued. Of these 27 (84 percent) developed into significant tropical cyclones. Five tropical cyclones were placed immediately into warning status without first issuing Formation Alerts because of their rapid development. There were 715 warnings issued for the

Table 1.--Western North Pacific significant tropical cyclones, 1978

CYCLONE	TYPE	NAME	PRD OF WARNING	CALENDER DAYS OF WARNING	MAX SFC WIND	MIN OBS SLP	NO. OF WARNINGS TOTAL	NO. OF WARNINGS AS TY	DISTANCE TRAVELLED
01	TS	NADINE	08 JAN-13 JAN	6	60	973	21		1340
02	TY	OLIVE	18 APR-26 APR	9	85	955	36	14	2669
03	TS	POLLY	16 JUN-20 JUN	5	50	985	16		788
04	TS	ROSE	23 JUN-24 JUN	2	40	993	7		352
05	TS	SHIRLEY	30 JUN-30 JUN	1	35	990	3		161
06	TY	TRIX	13 JUL-22 JUL	10	70	967	38	9	2326
07	TY	VIRGINIA	23 JUL-02 AUG	11	70	972	43	31	2052
08	TY	WENDY	24 JUL-03 AUG	11	80	962	42	27	1372
09	TS	AGNES	24 JUL-30 JUL	7	50	985	22		667
11	TS	BONNIE	10 AUG-12 AUG	3	40	984	9		481
12	TY	CARMEN	11 AUG-20 AUG	10	80	961	37	16	2076
13	TS	DELLA	11 AUG-13 AUG	3	45	984	10		774
14	TD	TD-14	19 AUG-20 AUG	2	30	991	6		556
15	TY	ELAINE	23 AUG-28 AUG	6	65	974	20		1036
16	TY	FAYE	28 AUG-07 SEP	11	105	936	44	17	2127
17	TS	GLORIA	29 AUG-01 SEP	4	40	990	12		553
18	TS	HESTER	30 AUG-01 SEP	3	50	987	11		851
19	TY	IRMA	12 SEP-15 SEP	4	65	972	15	3	854
20	TY	JUDY	13 SEP-17 SEP	5	90	950	18	10	1296
21	TS	KIT	21 SEP-26 SEP	6	50	992	21		1382
22	TY	LOLA	24 SEP-03 OCT	10	75	963	35	13	1672
23	TY	MAMIE	30 SEP-04 OCT	5	70	963	19	3	1578
24	TS	NINA	08 OCT-17 OCT	10	60	981	37		1299
25	TY	ORA	10 OCT-15 OCT	6	85	944	22	7	1370
26	TD	TD-26	11 OCT-12 OCT	2	30	998	7		519
27	TD	TD-27	15 OCT-16 OCT	2	20	1003	6		155
28	TY	PHYLLIS	15 OCT-22 OCT	8	95	953	30	17	1687
29	ST	RITA	17 OCT-30 OCT	14	155	878	51	34	4142
31	TS	TESS	01 NOV-07 NOV	7	60	975	22		1346
32	TD	TD-32	17 NOV-20 NOV	4	25	1002	12		296
33	TY	VIOLA	17 NOV-24 NOV	8	125	911	29	15	2042
34	TS	WINNIE	27 NOV-30 NOV	4	55	977	14		1287
			1978 TOTALS	131**			715	216	

** OVERLAPPING DAYS INCLUDED ONLY ONCE IN SUM

Table 2.--Frequency of typhoons by month and year

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AVERAGE (1945-58)	0.4	0.1	0.3	0.4	0.7	1.1	2.0	2.9	3.2	2.4	2.0	0.9	16.3
1959	0	0	0	1	0	0	1	5	3	3	2	2	17
1960	0	0	0	1	0	2	2	8	0	4	1	1	19
1961	0	0	1	0	2	1	3	3	5	3	1	1	20
1962	0	0	0	1	2	0	5	7	2	4	3	0	24
1963	0	0	0	1	1	2	3	3	3	4	0	2	19
1964	0	0	0	0	2	2	6	3	5	3	4	1	26
1965	1	0	0	1	2	2	4	3	5	2	1	0	21
1966	0	0	0	1	2	1	3	6	4	2	0	1	20
1967	0	0	1	1	0	1	3	4	4	3	3	0	20
1968	0	0	0	1	1	1	1	4	3	5	4	0	20
1969	1	0	0	1	0	0	2	3	2	3	1	0	13
1970	0	1	0	0	0	1	0	4	2	3	1	0	12
1971	0	0	0	3	1	2	6	3	5	3	1	0	24
1972	1	0	0	0	1	1	4	4	3	4	2	2	22
1973	0	0	0	0	0	0	4	2	2	4	0	0	12
1974	0	0	0	0	1	2	1	2	3	4	2	0	14
1975	1	0	0	0	0	0	1	3	4	3	2	0	15
1976	1	0	0	1	2	2	2	1	4	1	1	0	15
1977	0	0	0	0	0	0	3	0	2	3	2	1	11
1978	0	0	0	1	0	0	3	2	4	3	2	0	15
AVERAGE (1959-78)	0.25	0.05	0.10	0.70	0.85	0.95	2.85	3.55	3.25	3.20	1.65	0.55	17.95

Table 3.--Frequency of tropical storms and typhoons by month and year

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AVERAGE (1945-58)	0.4	0.1	0.4	0.5	0.8	1.3	3.0	3.9	4.1	3.3	2.7	1.1	21.6
1959	0	1	1	1	0	0	3	6	6	4	2	2	26
1960	0	0	0	1	1	3	3	10	3	4	1	1	27
1961	1	1	1	1	3	2	5	4	6	5	1	1	31
1962	0	1	0	1	2	0	6	7	3	5	3	2	30
1963	0	0	0	1	1	3	4	3	5	5	0	3	25
1964	0	0	0	0	2	2	7	9	7	6	6	1	40
1965	2	2	1	1	2	3	5	6	7	2	2	1	34
1966	0	0	0	1	2	1	5	8	7	3	2	1	30
1967	1	0	2	1	1	1	6	8	7	4	3	1	35
1968	0	0	0	1	1	1	3	8	3	6	4	0	27
1969	1	0	1	1	0	0	3	4	3	3	2	1	19
1970	0	1	0	0	0	2	2	6	4	5	4	0	24
1971	1	0	1	3	4	2	8	4	6	4	2	0	35
1972	1	0	0	0	1	3	6	5	4	5	2	3	30
1973	0	0	0	0	0	0	7	5	2	4	3	0	21
1974	1	0	1	1	1	4	4	5	5	4	4	2	32
1975	1	0	0	0	0	0	2	4	5	5	3	0	20
1976	1	1	0	2	2	2	4	4	5	1	1	2	25
1977	0	0	1	0	0	1	4	1	5	4	2	1	19
1978	1	0	0	1	0	3	4	7	5	4	3	0	28
AVERAGE (1959-78)	0.55	0.35	0.45	0.85	1.15	1.65	4.55	5.70	4.90	4.15	2.50	1.10	27.90

western Pacific region with 131 "warning days." Of these two or more cyclones existed on 46 days, and three cyclones existed on 16 days.

The cyclone tracks shown in figures 18 to 21 are based upon poststorm analysis. Dates on the tracks include the period from when the storm was first detected until it dissipated or became extratropical. In tables 2 and 3 the storms are credited to the month in which the first warning was issued. Numbers for past years in these tables may disagree with tables in previous annual articles as those tables indicated the month that the storm was first detected. Maximum winds are estimates of sustained windspeeds for a 1-min averaging period.

Individual typhoons are described in the following narratives. Times are GMT unless otherwise indicated. Tropical storm summaries can be found in the "Smooth Log" of the appropriate issue of the Mariners Weather Log.

OLIVE

In early April 1978 the near-equatorial trough (NET) slowly shifted northward and became more active as the Sun made its seasonal progression toward summer solstice. Within the NET, a surface circulation was first analyzed on the 11th at 1200 near 05°N, 155°E. It meandered southward then westward at about 8 kn for the next 4 days and eventually developed into the first typhoon of the year, Olive.

Anticyclonic outflow at the 200-mb level was first noted over the surface circulation on the 13th. By the 16th satellite imagery and synoptic data indicated increased organization, and the first warning was issued on the 18th. A subsequent aircraft fix found the central pressure at 1001 mb and estimated the maximum surface winds to be 30 to 35 kn.

The midtropospheric subtropical ridge was well established at this time with the east-west axis varying between 17° and 20°N. This resulted in the cyclone,

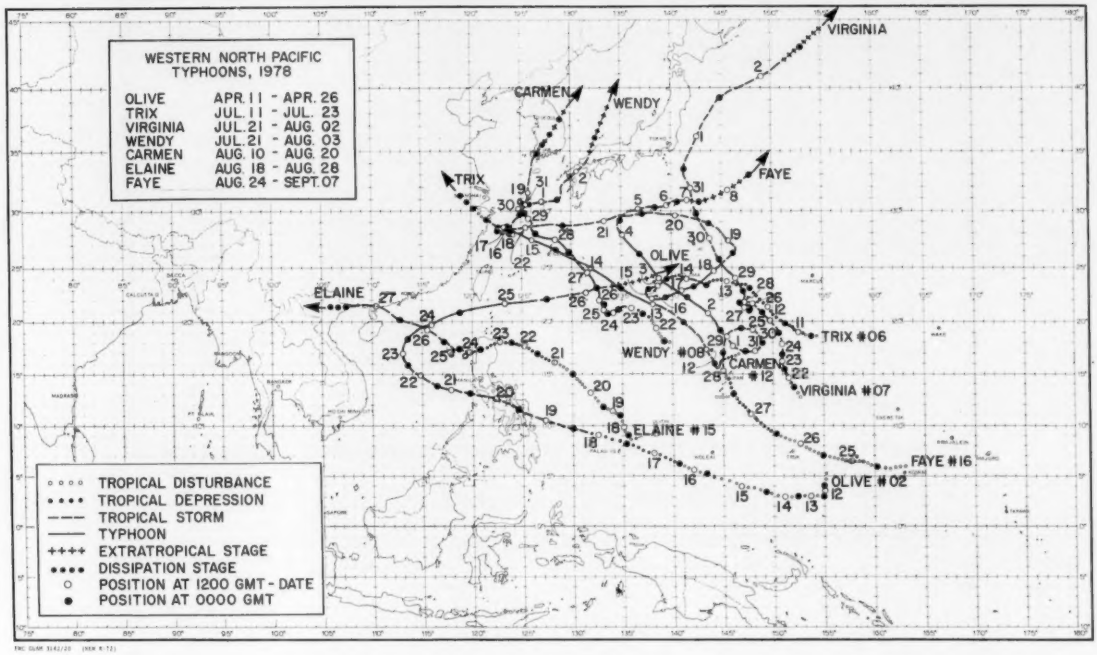


Figure 18.--Typhoon tracks, 1978.

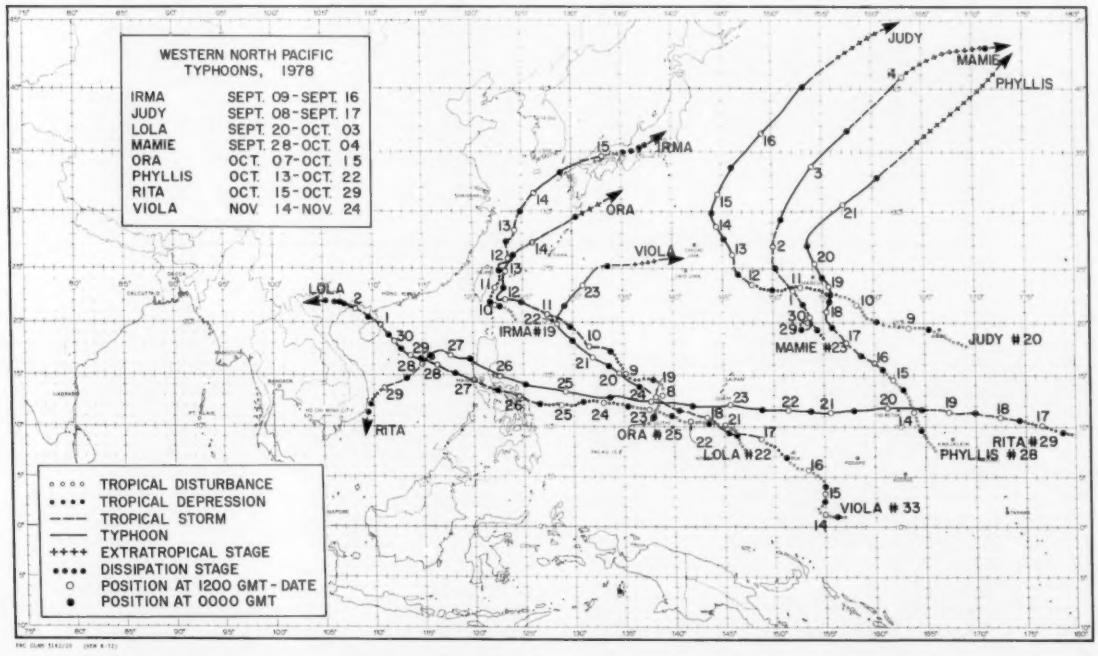


Figure 19.--Typhoon tracks, 1978.

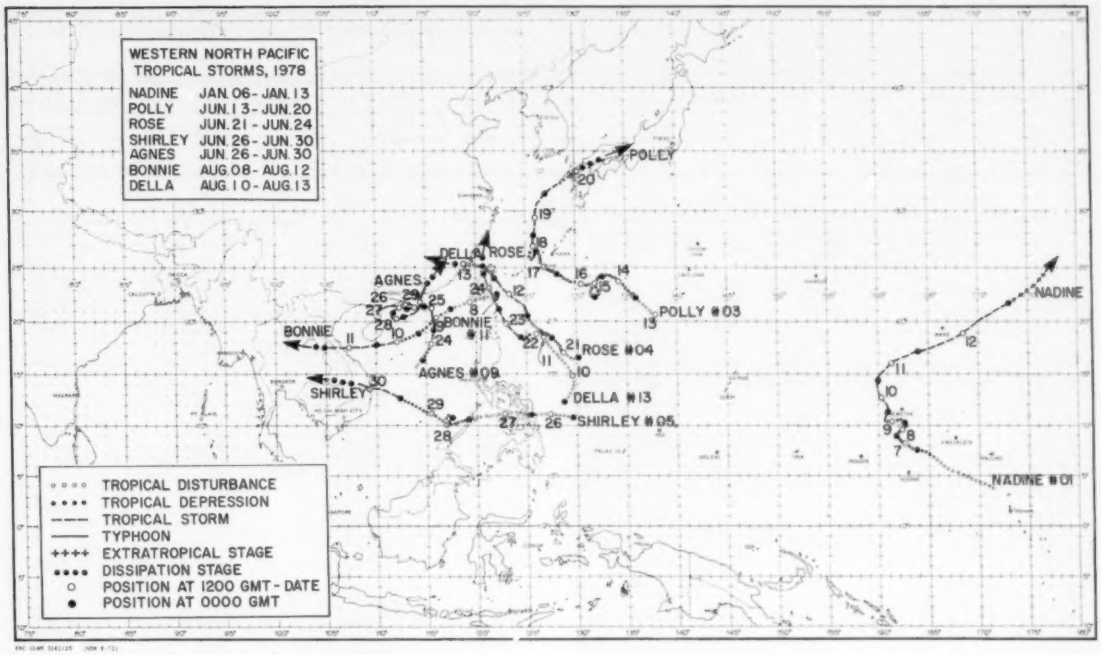


Figure 20.--Tropical storm tracks, 1978.

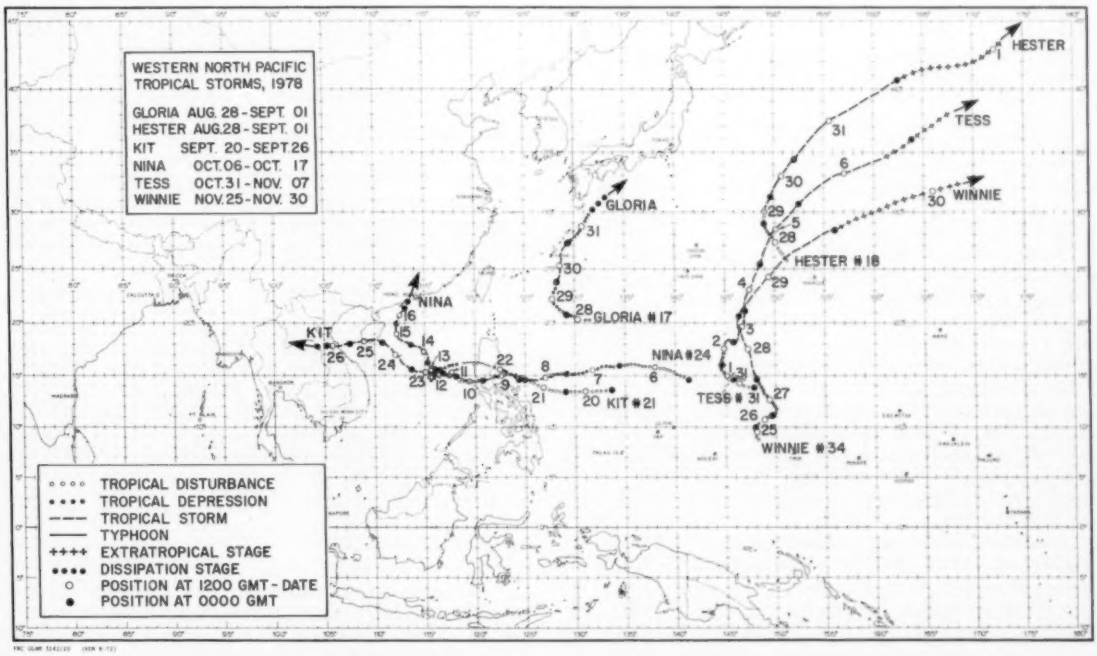


Figure 21.--Tropical storm tracks, 1978.

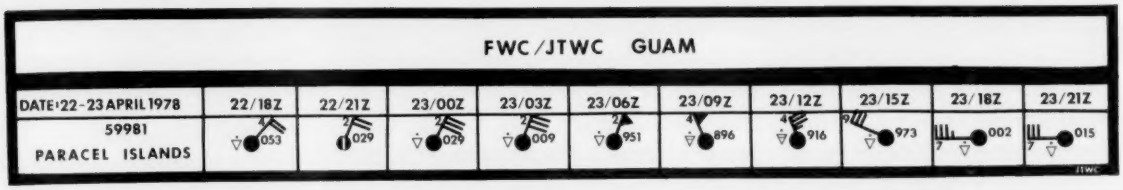


Figure 22.--Three-hourly surface synoptic observations from the Paracel Islands during the passage of typhoon Olive. Joint Typhoon Warning Center.

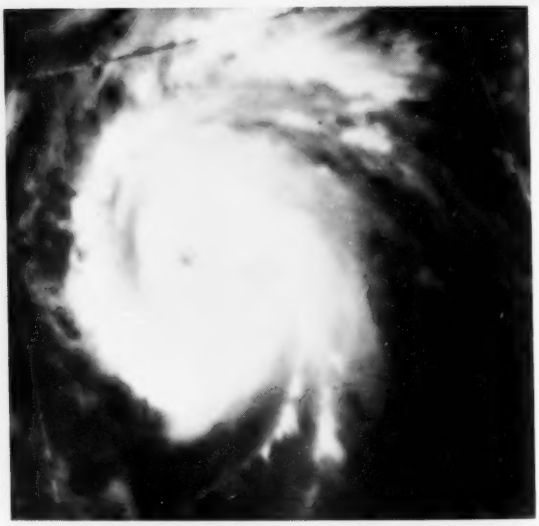


Figure 23.--Typhoon Olive on April 23 at peak intensity. (NOAA Imagery)

once organized, tracking west-northwestward at speeds faster than climatology. Satellite data indicated good outflow aloft with continuous intensification. The depression was upgraded to tropical storm Olive on the 18th at 1800, and she passed through the Leyte Gulf with maximum sustained winds of 60 kn.

While crossing the central Philippine Islands, Olive weakened to 45 kn. Upper level outflow remained good during the transit, and Olive exited intact into the South China Sea after 1800 on the 20th. The combination of good outflow aloft and warm water in the South China Sea caused Olive to reintensify, and she reached typhoon intensity at 0600 on the 22d. The storm recurved through a break in the subtropical ridge along 113°E. Figure 22 shows the 3-hourly surface reports from the Paracel Islands when Olive passed nearby. A maximum intensity of 85 kn (fig. 23) was reached on the 23d 12 hr before recurvature and continued until the 24th at 1200.

Recurvature was quite sharp due to strong, deep westerly upper air flow in the latitudes of 20° to 30°N. After recurvature Olive tracked to the east-northeast. Gradual weakening occurred as cooler, drier air was ingested into the storm, and Olive finally became extratropical over cooler waters at 1800 on the 26th.

TRIX

Trix, the season's second typhoon, was difficult to

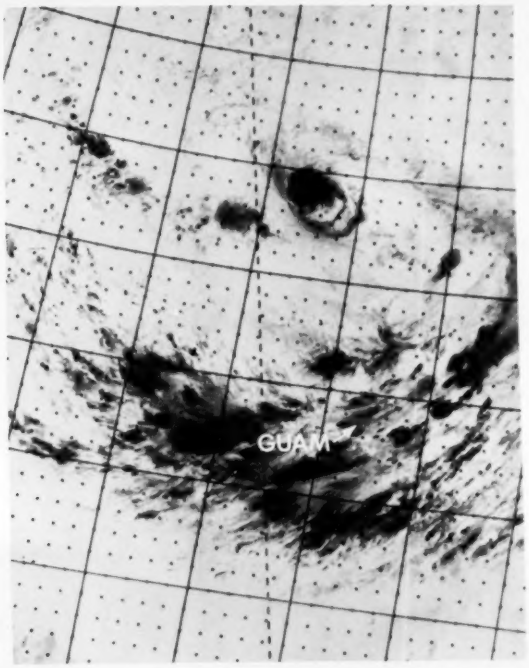


Figure 24.--Infrared image of Trix at tropical-storm intensity at 2220 on July 14. The cloudiness over Guam in the deep convergent southwest flow is quite a distance from Trix, signifying the large extent of the cyclonic circulation in which Trix was embedded. (DMSP Imagery)

forecast owing to an unusual track, which included a 4-day, 700-mi perimeter, cyclonic loop. The degree of difficulty was reflected in warning statistics such as 11 warning relocations, 2 warning amendments, and an average 24-hr forecast error of 174 mi.

Trix originated from a wave in the easterlies, which became significant along 148°E on July 10. A day later a surface circulation was noted within the wave 550 mi northeast of Guam. Over the next 48 hr, the wave drifted northwestward and moved under an area of diffluence caused by a tropical upper tropospheric trough (TUTT) to the west.

An aircraft reconnaissance flight into the alert area found a cyclonic circulation with a circular area of calm winds 100 mi in diameter. Based on this information and continued outflow aloft, the first warning was issued on the depression at 0600 on the 13th. Aircraft reconnaissance observed the sea-level pressure continuing to decrease, and tropical storm intensity was reached on

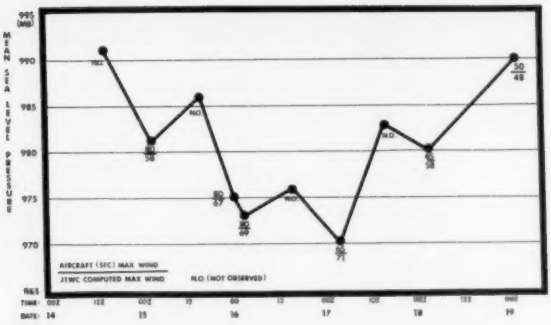


Figure 25.--Time cross section of Trix's minimum sea-level pressure. Joint Typhoon Warning Center.

the 14th at 0000. Satellite data at 2220 (fig. 24) showed Trix a very compact tropical storm with outflow only 3 degrees in diameter. Midget storms have been reviewed in literature and have been found to exhibit erratic intensity trends. Trix held true to form. Figure 25 shows the diurnal variation of the sea-level pressure as observed by dropsonde. Also shown are the differences between the maximum sustained surface winds as estimated from aircraft reconnaissance and those obtained from an empirically derived formula used by the Joint Typhoon Warning Center (JTWC).

In addition to erratic intensity trends, Trix's track was quite extraordinary. On the 15th at 0000, a large cyclonic circulation dominated the midtropospheric flow in the western Pacific between 13°N and 23°N. Trix, embedded in this large circulation, made a cyclonic loop along the periphery. During this loop, Trix traveled approximately 700 mi in 4 days. Trix continued intensifying while looping, and she attained typhoon intensity on the 16th. The Aerial Reconnais-Weather Officer reported on his postmission report that "the storm had all the typical parameters of a typhoon but on a miniature scale."

A large, subtropical high-pressure center began building near 40°N, 170°W, on the 19th. This feature finally provided the necessary strong easterlies to break Trix out of her loop. The subtropical ridge continued building westward over Japan steering Trix westward, and she made landfall on the east coast of China near Linhai by the 20th.

VIRGINIA

Virginia, the third typhoon of the 1978 season, was relatively small compared to the much larger typhoon Wendy which developed simultaneously to the west. Virginia's track was uncomplicated, except for an unexpected loop. She first appeared on satellite imagery as a small tropical disturbance on July 21. This disturbance was believed to be associated with a low-level convergence zone feeding into a much larger disturbance which was developing over the Philippine Sea. There were no nearby land/ship reports to indicate any evidence of a surface circulation at this time. On the 23d a weather reconnaissance aircraft was sent to investigate the larger disturbance and was later sent eastward into the smaller disturbance. The aircraft penetrated the smaller disturbance and found an unexpected, well-developed circulation. Aircraft radar showed a well-defined 40-mi diameter eye and estimated surface gusts of 55 kn. The first tropical cyclone warning was issued at 0600. Postanalysis showed tropical-storm stage was reached 6 to 12 hr before the first warning.

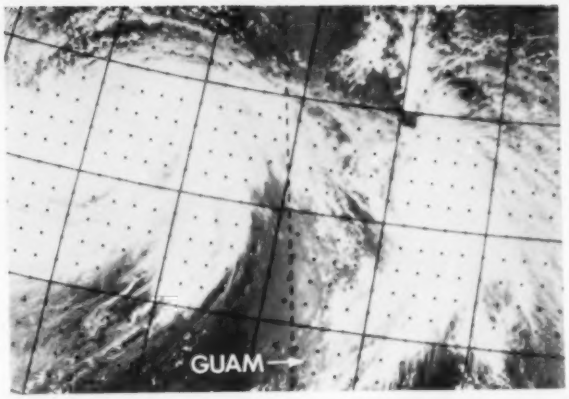


Figure 26.--Early stages of typhoons Wendy (left) and Virginia (right) on July 26 at 0133. (DMSP Imagery)

Virginia and Wendy intensified simultaneously (fig. 26). Because Wendy's circulation was so much larger, Virginia traveled in a counterclockwise direction about Wendy for the first 4 days. During the next 2 days, Wendy moved northwestward away from Virginia. Virginia decreased in speed and then executed a loop on the 27th and 28th. She attained maximum intensity of 70 kn on the 28th and 29th.

Virginia produced no known damage, even though she passed within 80 mi of Japan. Only 20-kn maximum surface winds were reported along the east coast of Honshu.

Virginia holds the 1978 record for a tropical cyclone tracking the farthest north (42°N) before losing its tropical characteristics.

WENDY

Wendy, the fourth typhoon of 1978, developed in a well-established monsoon trough. The trough, which had existed for 7 to 10 days prior to significant tropical-cyclone development, stretched from 07°N at the Dateline to the Mariana Islands and to the Luzon Straits. By July 22 two weak surface circulations were evident in the trough--one eventually became Wendy and the other Virginia.

Increased organization on the 22d prompted the initial reconnaissance aircraft launch. Surface winds of 25 to 30 kn were observed, but a definable surface circulation center could not be located. A formation alert was issued for an area 660 mi northwest of Guam, and Wendy reached tropical-storm intensity about 1800 on the 23d (fig. 27) and typhoon strength by 1800 on the 25th.

Wendy meandered westward from the 23d to the 25th. In response to stronger, midlevel southeasterlies, she accelerated northwestward and reached her maximum intensity of 80 kn and maintained it for 24 hr before she began a slow weakening trend after passing over the Ryukyu Islands. A marked decrease in low-level inflow and convection near the center seemed to affect Wendy's development at this point.

Wendy stalled in the central East China Sea, 180 mi east-southeast of Shanghai. The cooler and drier

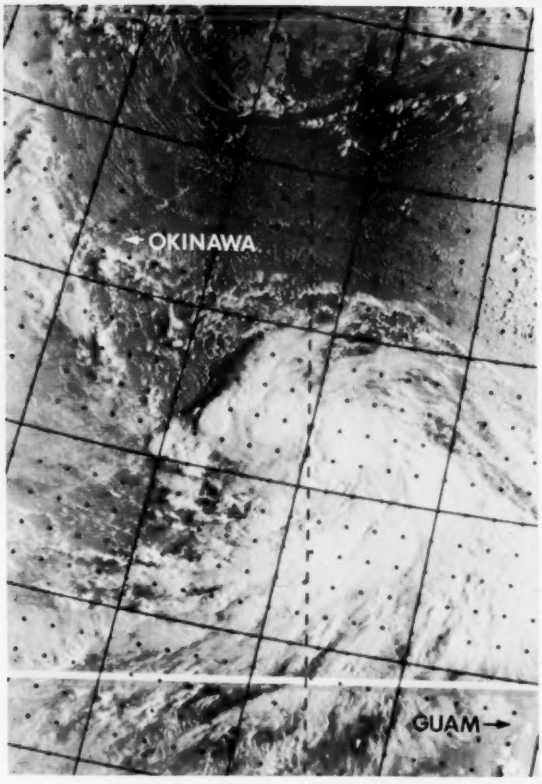


Figure 27.--Wendy as a young tropical storm on July 23. Typical of circulations in the monsoon trough, maximum cloudiness exists in the deep southwesterlies just south of the trough axis. (DMSP Imagery)

environment, decreased inflow, and decrease in outflow weakened Wendy. Most storms that stall in movement intensify; Wendy weakened.

Late on the 31st Wendy began to recurve northeastward. The cooler environment and increased frictional effects caused Wendy to weaken and lose tropical characteristics by August 2 after existing as a significant tropical cyclone for 10 days.

CARMEN

The genesis of typhoon Carmen provides an interesting example of the interaction of two synoptic features in generating a tropical cyclone. These features began interacting on August 7. On that day Guam's surface winds shifted from easterly to southwesterly as the southwest monsoon surged well east of its normal habitat. METSAT imagery showed a noticeable upsurge in convective activity along and to the south of the low-level monsoon trough. At the same time a tropical upper tropospheric trough northwest of Guam was deepening southward. Satellite-derived upper air winds confirmed considerable divergence existed. This upper level/lower level interaction persisted for the next few days. On the 10th aircraft data reported a 992-mb central pressure, and the first warning was issued at 0600 on the 11th with 40-kn intensity. Meanwhile, the activity in the monsoon trough had also rapidly organized in another area; tropical storm Della was forming just to the east of the Philippines.

Initially, Carmen's track was expected to be climatological since the overall synoptic environment in which Carmen was situated was typical of the August climatology. A strong, midtropospheric, subtropical ridge was north of her, and Carmen was forecast to follow a west-northwestward track. But Carmen moved erratically for 1 day and then accelerated to the north-northwest.

On the 12th Carmen was moving north-northwestward with an intensity of 55 kn. Three days later she only had intensified to 80 kn--an intensification rate which was half of the average rate for August cyclones. A partial explanation for this slow intensification was the fact that Carmen had a faster-than-average forward speed of 16 kn and also that she was part of a two-storm situation (fig. 28).

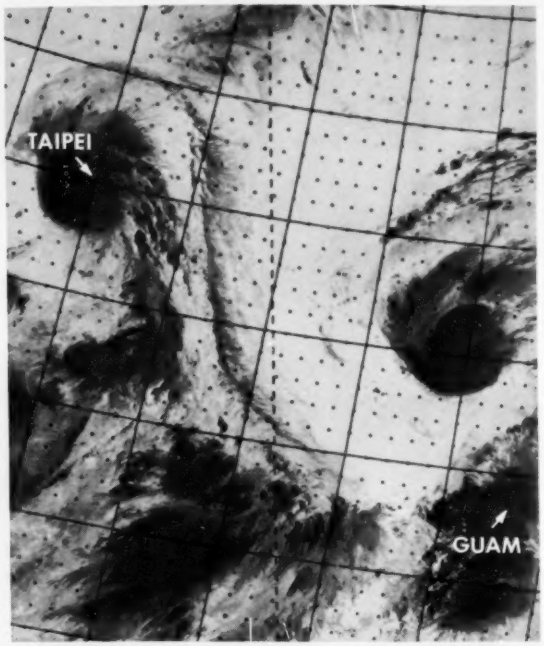


Figure 28.--Infrared image of typhoon Carmen (right) and tropical storm Della (left) on August 12 at 2134. (DMSP Imagery)

On the 15th satellite imagery (fig. 29) showed a more symmetrical typhoon but small in areal extent. The strong midtropospheric subtropical ridge still existed to the north and Carmen was expected to track westward into the China coast. However, a high-pressure cell was building ahead of Carmen over the Asian coast. By the 16th Carmen was caught in a weak steering flow between high-pressure cells to the east and west, and for 3 days Carmen looped erratically and weakened in intensity. On the 17th a developing short-wave trough was analyzed over the Asian mainland. At 1200 on the 18th Carmen began to track northward and eventually dissipated over Korea. Despite her erratic behavior, 24-hr forecast errors matched the average for the year.

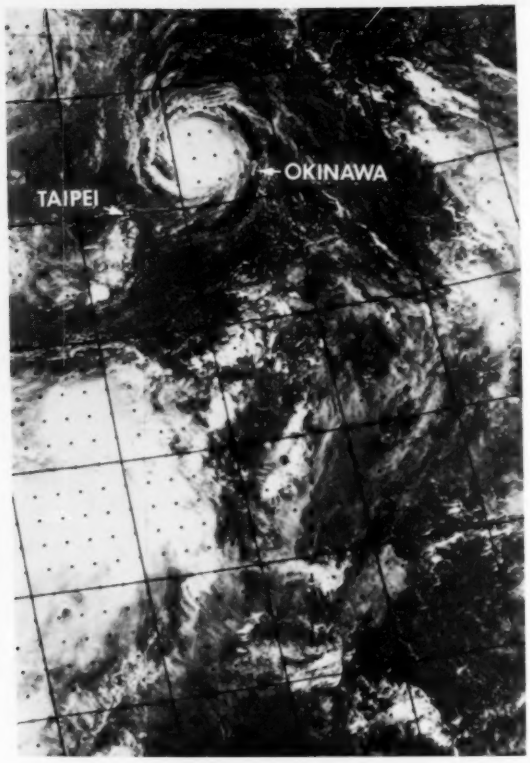


Figure 29.--Carmen's small areal extent, August 15 at 1505. (DMSP Imagery)

During her lifetime Carmen was responsible for considerable damage. Before dissipating over South Korea, she caused widespread flooding, 21 deaths, and $3 million worth of property damage. Saipan, affected by Carmen in her formative stages, reported flooding and property damage and was designated a national disaster area. At maximum intensity of 80 kn, Carmen passed over Okinawa about 26 mi north of Kadena Airbase with little damage.

ELAINE

On August 17 the monsoon trough extended as far east as 140°E, providing the breeding ground for typhoon Elaine. Synoptic and satellite data on the 18th showed a tropical disturbance with maximum winds of 15 kn organizing northeast of Palau. The relative position of the tropical upper tropospheric trough, north of the disturbance during this period, indicated suppression of the upper level outflow in the northern portion of the system. The initial warning was issued at 0600 on the 23d by which time increased organization and banding features were indicated on satellite imagery. Postanalysis indicated the system was a tropical depression 36 hr prior to this time.

On the 23d the midtropospheric ridge provided more definitive east-northeasterly steering flow across northern Luzon, resulting in Elaine's southwestward track, which was contrary to the favored climatological track to the west-northwest. Climatological studies also indicate weakening during passage over Luzon. Based on synoptic data, however, Elaine continued to intensify and was upgraded to a tropical storm at 0000 on the 24th while still over land 170 mi north of Manila. Heavy storm damage was reported in northern Luzon.

As Elaine exited Luzon into the South China Sea, her associated cloud pattern lacked sufficient organization for optimum satellite and radar fixes; aircraft reconnaissance at low flight levels (restricted at times by terrain) was heavily relied on for definitive surface center fixes. During this same period of the 24th and 25th, Elaine was caught between strong southwest monsoon flow and strong northeasterly flow. As a result, she looped twice. After completing the second loop, Elaine accelerated northwestward then northward. The closest point of approach to Hong Kong occurred at 0200 on the 27th with Elaine 155 mi to the southwest.

At 0300 on the 27th the SEAL AND TRADE (21°N, 113°E) reported surface winds of 65 kn and a surface pressure of 974 mb. Based on this ship report, the storm was upgraded to a typhoon just prior to landfall over the southern coast of China near the Luichow Peninsula (fig. 30).

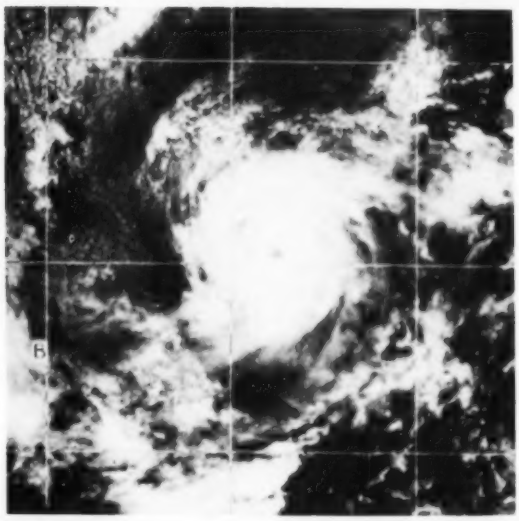


Figure 30.--Typhoon Elaine caught at maximum intensity on the 27th.

FAYE

Typhoon Faye, the seventh of the season, was one of the most interesting. Besides executing an uncommon anticyclonic loop early in her development, Faye also unexpectedly reintensified to typhoon strength just before becoming extratropical.

The tropical disturbance that was to become typhoon Faye was first sighted southeast of Ponape at 2142 on August 24 by satellite reconnaissance. The disturbance moved west-northwestward and on the 26th passed north of Truk. Based on an improved satellite signature and ship synoptic data, an alert was issued late on the 27th. Shortly thereafter, reconnaissance aircraft confirmed the existence of a closed surface circulation with a min-

imum sea-level pressure of 1000 mb, and the disturbance was upgraded to a tropical depression.

At 0600 on the 28th the disturbance passed 60 mi to the northeast of Guam and was upgraded to tropical storm Faye 6 hr later. During the next 24 hr the storm moved straight north while slowly intensifying. The 500-mb flow pattern became complex during this period owing to the influence of two new developing tropical systems--tropical storm Gloria between Luzon and Japan and tropical storm Hester west of Marcus Island (fig. 31).

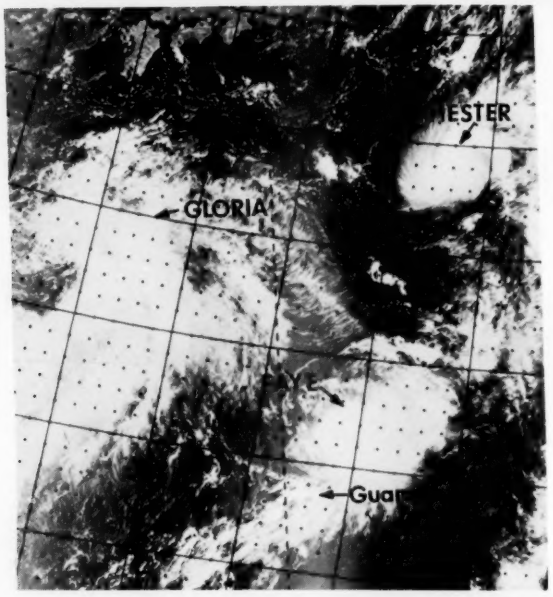


Figure 31.--Tropical storm Faye just prior to executing an anticyclonic loop north of Guam, while at an intensity of 40 kn. Tropical storm Gloria is southeast of Okinawa and tropical storm Hester is northwest of Marcus Island, 0137 August 29. (DMSP Imagery)

By 1200 on the 29th Faye began to execute a rare, anticyclonic loop. The 500-mb analysis of 0000 on the 30th (fig. 32) showed Faye now positioned between two high-pressure centers: one between Marcus Island and the Volcano Islands and the other south of Guam. This pattern was the result of the combined influence of Gloria, Hester, Faye, and a long-wave, midlevel trough that was developing far to the northeast of Faye. Faye could now choose one of two routes: (1) north-northeastward in the weakness between Marcus Island and Wake Island or (2) west-northwestward along the southern periphery of the high-pressure center to her north.

Faye reached the southernmost point of her looping track on September 1 and was upgraded to a typhoon at 0600 based upon the development of a poorly defined eye and a central pressure of 984 mb as reported by reconnaissance aircraft. She was now under the influence of southeasterly steering flow and began tracking steadily northwestward around the western periphery of the ridge. By late on the 4th Faye had weakened to tropical-storm strength and began to recurve to the northeast.

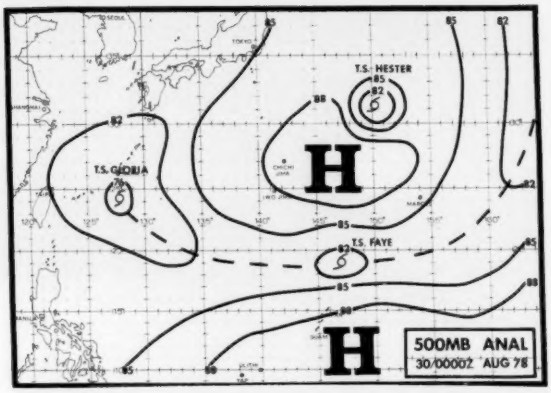


Figure 32.--The 500-mb analysis at 0000 on the 30th showing Faye, Gloria, and Hester. Joint Typhoon Warning Center.

Normally, a system would be expected to accelerate and continue to weaken after recurvature as it moves over cooler water, begins to entrain cold air at midlevels from the north, and comes under the influence of strong vertical wind shear. However, a reconnaissance aircraft reported on the 5th that Faye's central pressure had dropped to 975 mb with an overall increase in organization. Faye was again upgraded to a typhoon based on aircraft reconnaissance and ship data at 1800. Aircraft reports indicated that Faye was distinctly warm core at this time. Because of the weak flow between 500 and 200 mb, the vertical wind shear was small, and thus Faye was able to maintain vertical organization longer than anticipated.

By 1200 on the 6th Faye had again weakened to tropical-storm intensity from the increasing vertical wind shear. The final warning was issued on the 7th at 1800 at which time Faye was fully extratropical and in the process of merging with the polar front.

Although typhoon Faye avoided the major land masses of the Pacific area, she did cause damage to the northern Mariana Islands. During her anticyclonic loop, the islands of Agrihan, Alamagan, and Pagan were directly affected twice. Pagan sustained the most damage with 65 homes destroyed and one merchant vessel grounded.

IRMA

Irma, the eighth typhoon of the season, developed in the monsoon trough southeast of Taiwan. Aircraft reconnaissance at 0935 on September 12 showed that the tropical depression had undergone rapid development, and it was upgraded to a tropical storm. Diffluence aloft, ahead of the short wave, allowed Irma to reach a maximum intensity of 65 kn by 1200 on the 14th (fig. 33). Irma remained a typhoon for only 12 hr, becoming the shortest-lived typhoon of the season.

In the last 24 to 36 hr of her existence, Irma experienced increased vertical shear which brought on rapid weakening. The terrain effects of Kyushu and

Although she was a typhoon for only 12 hr and weakened rapidly as she tracked towards southwest Japan, Irma produced widespread damage to Kyushu with gusts estimated in excess of 100 mi/h. Irma smashed windows, overturned cars, and capsized several fishing boats. Several athletes at the Japan-China Friendship

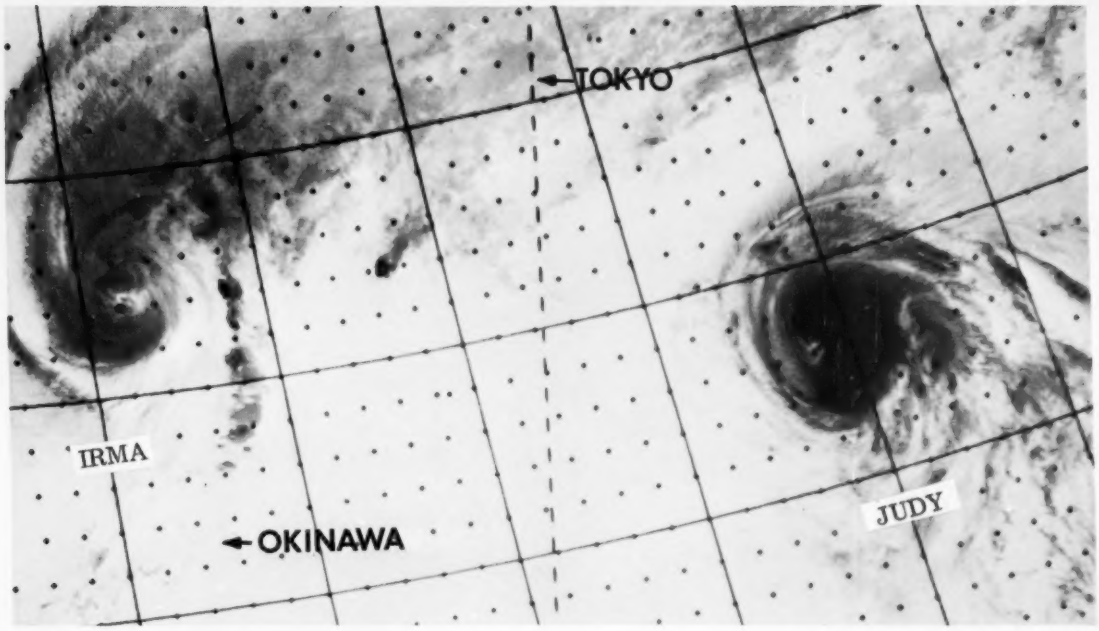


Figure 33.--Infrared imagery of typhoons Judy (right) and Irma (left) on September 14 at 1438. (DMSP Imagery)

Track and Field Meet in Kitakyushu were injured when a freak gust blew them 10 ft in the air.

JUDY

Typhoon Judy was first evident on satellite imagery as an area of convective activity in the easterlies. Further evidence of the initial disturbance was provided by surface observations from Wake Island during 1200 on September 8 until 0000 on the 9th which showed a wind shift, maximum sustained winds of 20 kn, and a minimum sea-level pressure of 1005 mb. For the next 3 days the disturbance was monitored by satellite reconnaissance. Aircraft data along with satellite imagery late on the 12th supported a cyclone of tropical-storm intensity. The first warning was issued at 0000 on the 13th.

From the time of the first warning until the last, Judy's track was one of classical recurvature, slowing in forward movement to 5 kn at the recurvature point and accelerating to 31 kn under strong westerly upper level steering north of the subtropical ridge axis. Although part of a two-storm situation with typhoon Irma (fig. 33), Judy never appeared to be influenced by Irma's presence. Judy reached typhoon strength on the 14th and attained a maximum intensity of 90 kn on the 15th and 16th. She weakened rapidly to tropical-storm status by the 17th as she merged with an extratropical system.

LOLA

Typhoon Lola was spawned in a very active trough between the Equator and 12°N from the Philippines eastward to 150°E. Between September 20 and 24, the disturbance slowly accelerated to the northwest then west-northwestward through the Caroline Islands, passing between Ulithi and Guam on the 22d with 15- to 20-kn winds. Based on aircraft and satellite data, the first warning was issued on the depression at 1200 on the 24th with 25-kn winds.

Aircraft data at 2100 on the 25th positioned the circulation 110 mi east of Samar. Increased organization and a central pressure of 995 mb were noted, which sulted in upgrading the system to tropical storm Lola at 0000 on the 26th. Landfall was made on the southeastern tip of Luzon at 1500. On the 27th Lola moved along the southern coast of Luzon passing over the cities of Legaspi and Batangas. The closest point of approach to Manila occurred at 1000 as Lola passed 35 mi to the southwest. At this time the International Airport at Manila reported 30-kn sustained winds with gusts to 50 kn. The Naval Weather Service Environmental Detachment at Cubi Point recorded maximum sustained winds of 40 kn with a peak gust of 59 kn at 1241. Nineteen deaths and heavy property damage in southern Tagaloc and Bical regions were attributed to Lola's passage.

Supported by good upper tropospheric outflow and strong low-level energy input, gradual intensification occurred from 1800 on the 27th through 1800 on the 30th. Based on aircraft data, Lola was upgraded to typhoon intensity at 1800 on the 28th. During the 29th and 30th Lola reached maximum intensity with sustained winds of 75 kn and a minimum pressure of 963 mb. The midtropospheric ridge began strengthening westward resulting in Lola's track becoming more west-northwestward toward Hainan Island. Landfall over Hainan occurred at 0900 on October 1, 10 mi southeast of Wenchang. Weakened by terrain features, Lola was downgraded to a tropical storm at 1200 as she continued west-northwestward into northern Viet-

nam. The final warning was issued on the depression at 0000 on the 3d.

MAMIE

Typhoon Mamie was yet another of the compact typhoons of 1978. Mamie was also an open-ocean typhoon as she formed and dissipated over the ocean and affected shipping lanes but never really threatened any land stations.

Mamie developed from a wave in the easterlies. On September 27 this wave was approximately 100 mi from Guam. Within the wave, there were two disturbance areas. The northernmost area eventually developed when it moved under an upper air diffluent region. By the 30th a compact tropical depression was easily noted on satellite data. Also noted were cirrus cloud streamers showing outflow existed in all quadrants. The first warning was issued immediately thereafter.

Remaining a very compact system (fig. 34), Mamie tracked on a recurvature path along the western periphery of a midtropospheric, subtropical high-pressure system whose 500-mb height center was near 25°N, 175°E. Mamie produced typhoon-force winds on October 2 with a maximum of 70 kn. These decreased to less than typhoon strength late on the 3d, and she was extratropical on the 4th.

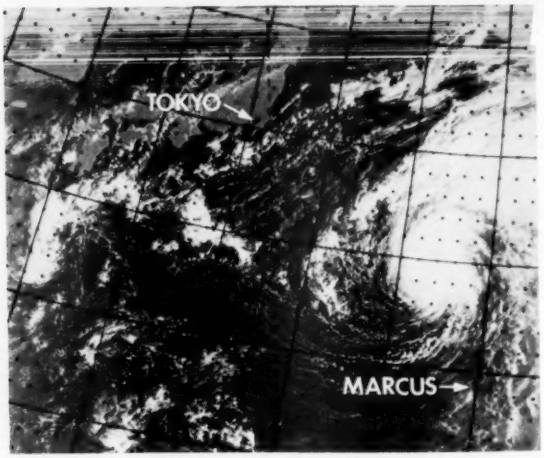


Figure 34.--Typhoon Mamie, remaining compact, is moving northeastward at maximum intensity of 70 kn on October 3 at 0123. (DMSP Imagery)

ORA

During early October extensive monsoon troughing existed from the South China Sea, across the Philippine Islands, to an area southeast of Guam. The surface analyses for that period showed a combination of strong northeasterlies north of the monsoon trough axis and well-defined, cross-equatorial flow into the trough from the Southern Hemisphere. The entire area, therefore, was ripe for continued tropical cyclone development and, indeed, by October 8 tropical storm Nina was gathering strength east of the Philippines. At about the same time an area of convergence about 300 mi west-southwest of Guam began to show increased organization.

The JTWC began to monitor this area using satellite and ship synoptic data. Based on reconnaissance aircraft data the disturbance was upgraded to tropical storm Ora with the first warning valid at 0000 on the 10th. The forecast showed Ora recurving to the north-northeast around the western periphery of the high-pressure cell that was centered near Marcus Island. However, by 1800 on the 10th, it became apparent that Ora and Nina were beginning to interact. At this time Nina, the dominant system, was trying to force Ora to follow a westward track, while at the same time the long-wave trough, then over the Sea of Japan, was inducing more northward movement. The net effect of these two steering influences caused Ora to follow an overall northwestward track.

On the 11th it was apparent that tropical storms Ora and Nina were engaging in a Fujiwhara interaction. Nina would have been expected to move eastward in the classic Fujiwhara style. However, because she was the dominant system, the axis of rotation was closer to her. Figure 35 shows the relative positions of Nina and Ora at 2342 on the 11th. Instead of moving eastward, Nina merely stalled and then executed two small loops, while causing Ora to move west-northwestward. Ora then began to show increased organization on satellite and radar data. Aircraft reconnaissance on the 12th reported the first signs of eye formation and a central pressure of 969.6 mb. Typhoon intensity was reached at 1800 on the 11th.

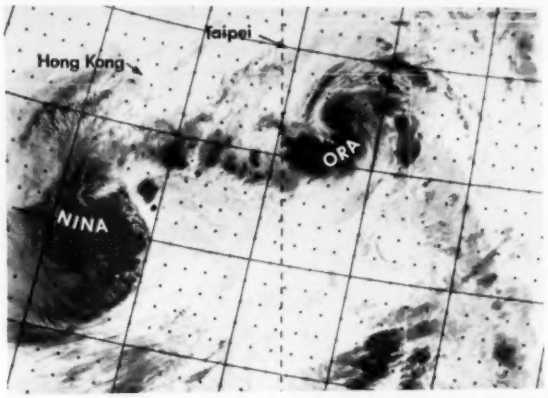


Figure 35.--Infrared image of typhoon Ora and tropical storm Nina during Fijiwhara interaction, 2342 October 11. Postanalysis showed that when the feeder band connecting the two cyclones disappeared, interaction ceased and Ora later turned north. (DMSP Imagery)

As Ora approached the east coast of Taiwan, hourly radar fixes from Ishigaki-Shima, Miyako-Jima, and Hua-lien indicated deceleration. By this time, tropical storm Nina had evidently weakened to the point where she no longer had any major influence on Ora's movement. Fortunately for Taiwan, Ora veered sharply to the north and never made landfall there, but heavy rain which preceded her caused widespread flooding and landslides. Rainfall in the mountains reached 44 in. Floods disrupted transportation in Taipei, and five people were reported dead and two missing. Winds of 54 kn hit the northeast coast.

Ora reached peak intensity of 85 kn as a compact typhoon at 0600 on the 13th (fig. 36). By 1800, reconconaissance aircraft indicated that her central pressure had increased rapidly (44 mb in 17 hr) and there was evidence that her upper level center was beginning to shear off. By the 14th Ora had weakened to tropical-storm strength and was accelerating to the northeast under the influence of strong midlevel westerlies. Ora merged with the polar front and was fully extratropical by 0600 on the 15th.

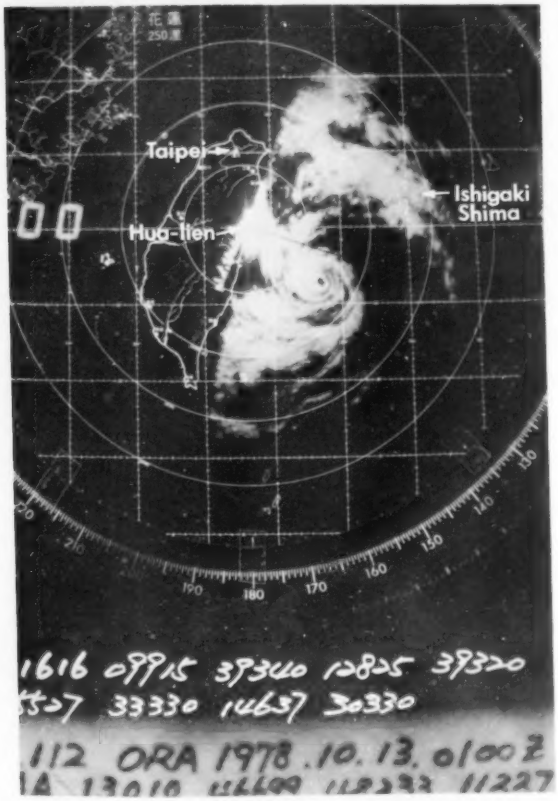


Figure 36.--Hua-Lien radar presentation of typhoon Ora at 0100 October 13 just prior to her reaching maximum intensity. Photo courtesy of Central Weather Bureau, Taipei, Taiwan.

PHYLLIS

The tropical disturbance that eventually developed into typhoon Phyllis formed in a well-established, near-equatorial trough lying over the southern Marshall Islands on October 13. Increased organization of the disturbance was observed on satellite imagery on the 14th, and it was upgraded to a tropical depression on the 15th.

Phyllis remained a tropical depression for 18 hr and was upgraded to a tropical storm based on aircraft reconnaissance information, which indicated that Phyllis was a small compact storm with small wind radii and therefore virtually invisible from synoptic reports alone. Phyllis continued to have excellent outflow aloft, and she gradually intensified to typhoon strength by the 17th at 1800.

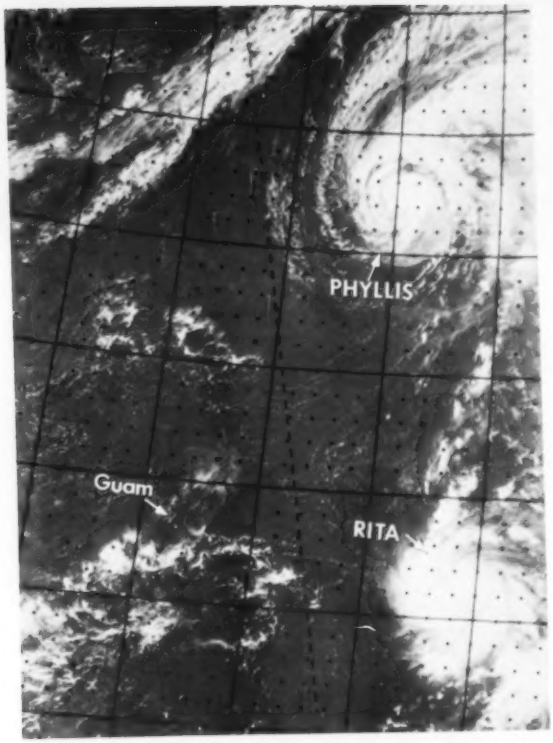


Figure 37.--Typhoon Phyllis at her recurvature point, typhoon Rita on a track toward Guam, and the subtropical ridge builds in between them as noted by the weakness in the band of showers connecting the two compact typhoons, 0106 October 21. (DMSP Imagery)

On the 19th a high-pressure system east of Phyllis began building to the west which eventually caused her to slowly accelerate northwestward and delayed recurvature. Cooler waters and reduced upper level outflow weakened Phyllis as she recurved northeastward (fig. 37). Her forward speed increased to 45 kn.

Increased vertical shear caused Phyllis to weaken to tropical-storm intensity by 0000 on the 22d. Thereafter, the pressure gradient between a major surface low moving eastward off Japan and the strong surface ridge east of Phyllis helped maintain storm-force winds around Phyllis as she became extratropical on the 22d.

Phyllis remained a typhoon for 4 days during which her closest approach to land was 40 mi northeast of Marcus Island. Her compactness and track over open water resulted in no major damage reported.

RITA

Rita, the only supertyphoon of the season, was first detected as a cloud cluster in the tropical central North Pacific on October 14. She migrated westward and crossed the Dateline early on the 16th. At 2300 satellite imagery showed increased organization and developing feeder-band activity. The first warning was issued on the 17th with 30-kn intensity. Thus, Rita was detected very early in her developmental stages.

From the time of the first warning until landfall on the Philippines, Rita tracked virtually straight westward. The major influence on her movement was the unusually strong midtropospheric subtropical ridge that built as Phyllis recurved. The strength of the easterly current south of the ridge steered Rita at forward speeds of up to 23 kn, almost twice that of the climatological average. During her track Rita threatened a number of Pacific islands and atolls, including those in the northeastern Marshalls, Enewetak, and Guam. Rita's track near Enewetak brushed the northern tip of the atoll with maximum sustained winds of 75 kn. At this time Rita was a very compact typhoon, and the main island on the southeastern portion of the atoll reported maximum sustained winds of only 35 kn with gusts to 45 kn. By the time Rita approached Guam (fig. 38), she had intensified dramatically to 150 kn and, therefore, posed a serious threat to the island.

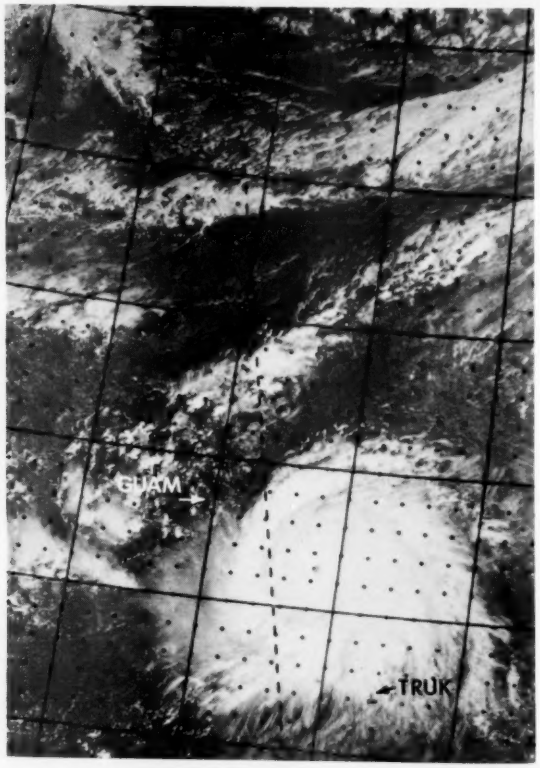


Figure 38.--Rita at 145-kn intensity, 16 hr before her closest point of approach to Guam at 2212 October 22. (DMSP Imagery)

Rita was forecast to track south of Guam with maximum sustained winds of 70 kn expected at the Naval Air Station, Agana, in the center of the island. Rita did indeed track south of Guam as forecast, but her maximum sustained winds reported at NAS Agana were only 35 kn with gusts to 55 kn. In addition, precipitation on the island from Rita was unusually low. Rita's actual track was 30 to 35 mi south of the forecast track with the closest point of approach to NAS Agana of 85 mi. Because she was compact, this 30-mi error in

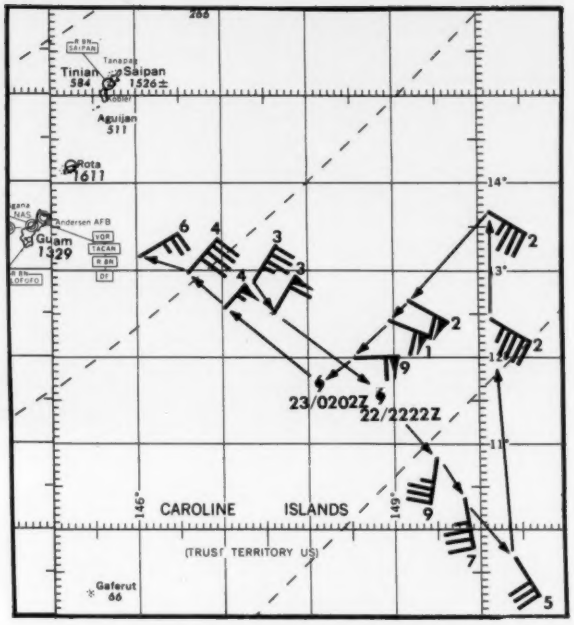


Figure 39.--Plot of aircraft reconnaissance data. Typhoon positions are noted at 0200 on the 23d and 2222 on the 22d. Wind barbs are the estimated surface winds from the ARWO aboard the aircraft. The tens digit of the wind direction is plotted with the wind barbs. Joint Typhoon Warning Center.

track meant a large difference in Rita's influence on Guam. Figure 39 shows a plot of wind values from a reconnaissance aircraft.

Unlike the relatively mild influence on Guam and Enewetak, the Philippines experienced considerable damage and many lives were lost during Rita's passage. Heavy flooding was reported throughout many of the cities and villages on Luzon, especially those just east and north of Clark Air Base. Winds up to 120 kn reportedly hit northern Luzon along with torrential rains and floods. Some 250,000 people were reported homeless with 337 dead. Damage was estimated to reach $100 million. As Rita entered the South China Sea, aircraft and satellite data showed that she had weakened considerably.

In contrast to the persistent synoptic situation over the western Pacific which had steered Rita westward, the large-scale features in the South China Sea were complex. As Rita exited the Philippines, a short-wave trough was developing and moving eastward over the Asia mainland. During this same time a surge in the northeast monsoon was developing over China at low tropospheric levels which tended to steer Rita southward. Eventually the northeast monsoon surge proved to be the deciding factor in Rita's movement, and she tracked southwestward toward the Vietnam coast and dissipated over water.

Overall, Rita was the record setter for the 1978 season. Her track was the longest, and at her peak intensity of 155 kn, aircraft recorded a central pressure of 878 mb, 2 mb higher than the record set by typhoon June in 1975.

VIOLA

Of the typhoons of 1978, none could be considered

more classic or well-behaved than typhoon Viola, the last typhoon of the season.

Increased convective activity in the monsoon trough about 600 mi southeast of Truk was first noticed on satellite data on November 13. Well-defined upper atmospheric outflow was evident in all quadrants, and at 0710 on the 17th a reconnaissance aircraft reported surface winds of 30 kn with a surface pressure of 998 mb. Based on this information the disturbance was upgraded to a tropical depression, and numbered warnings began. Under the influence of the strong easterlies south of the midtropospheric ridge, the depression tracked west-northwestward toward Luzon.

Based on an improved satellite signature, Viola was upgraded to a tropical storm at 1200 on the 17th. Careful comparison of the satellite data and aircraft reports indicated that Viola was still not vertically stacked. Late on the 19th she slowed to 8 kn, and the deceleration was apparently enough to allow her time to become better organized in the vertical. At 1505 reconnaissance aircraft confirmed that the surface center was within 5 mi of the 700-mb center, the surface pressure had fallen to 977 mb, and an eye was beginning to form. Viola reached typhoon strength by 0000 on the 20th. She attained her minimum sea-level pressure of 911 mb by 1200 on the 21st and maximum windspeed of 125 kn, just 5 kn below supertyphoon strength (fig. 40). Viola's tremendous intensification is reflected in the 10,000-ft temperatures that were reported by aircraft at about that time; the outside temperature was 14°C, but the inside (eye) was a very warm 29°C.

In an attempt to obtain more steering-level data to augment the sparse land station reports, reconnaissance aircraft were requested to fly at 500 mb in the area directly north of Viola. The wind data provided was invaluable and confirmed that a definite break in the ridge axis existed. The first forecast noting a recurvature track was issued at 0600 on the 22d. Subsequent aircraft and satellite fixes verified northward, then northeastward movement. The cargo shifted in the GIANT NAVIGATOR, and the ship developed such a list that the crew abandoned ship. Nine were missing. The ship sank on the 25th about 130 mi southwest of Ishigaki Shima. The HIMAWARI MARU was missing in the same general area.

After recurvature, satellite data began to show that Viola's upper level center was being sheared off from her surface circulation center. By 1800 on the 23d she had weakened to tropical-storm strength, and she weakened rapidly thereafter. Reconnaissance aircraft was unable to locate a 700-mb center on the 24th. A weak low-level circulation remained for a short time after losing tropical characteristics.

ACKNOWLEDGMENT

The Editor wishes to extend his appreciation to the Joint Typhoon Warning Center, U.S. Fleet Weather Central, Guam, for their outstanding cooperation in allowing the use of their Annual Typhoon Report from which this article was extracted. Also, we appreciate the use of their original charts and illustrations.

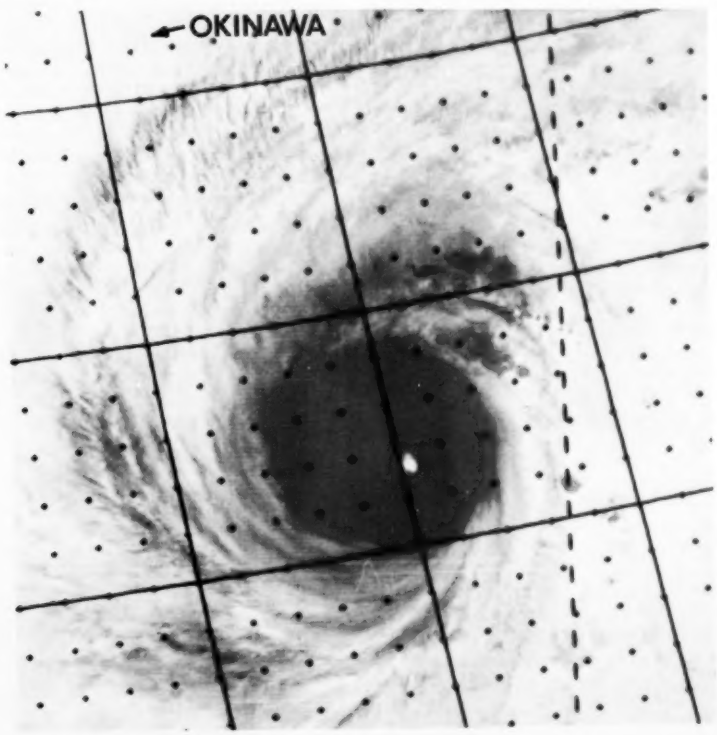


Figure 40.--Infrared image of typhoon Viola nearing her maximum intensity of 125 kn at 0945 on November 21. (DMSP Imagery)

Hints to the Observer

PRELIMINARY REPORT ON WEATHER MESSAGES RECEIVED FROM U.S. COOPERATING SHIPS

Robert G. Quayle
Environmental Data and Information Service, NOAA
Asheville, N.C.

As part of the Global Weather Experiment ("Hints to the Observer," Mariners Weather Log, Vol. 22, No. 5, Sept. 1978) the National Climatic Center (NCC) receives surface ships' weather observations from two sources:

1. Radio--automated magnetic tapes of radio OBS METEO reports; and

2. Mail--key-punched magnetic tapes of mailed logbook observations from NOAA Form 72-1.

In theory, the "radio" observations from U.S. ships should be included in the "mail" receipts. In reality, however, this is far from true. A large number of observations received by radio are never received by mail. This is presumably the result of logbooks which are lost or never mailed. Preaddressed, postage-free envelopes can be obtained by contacting any Port Meteorological Officer.

NCC compared the mail and radio sources for the 4-mo period of November 1978 through February 1979. The average monthly statistics are given below.

	Monthly Average
a. Radio reports from ships of all nations (including Ocean Weather Stations, but not buoys)	105,000
b. Radio reports from ships cooperating in the U.S. program using Form 72-1 (U.S. cooperating ships may be other than U.S. registry; e.g., Liberian)	11,500*
c. Mail reports from U.S. cooperating ships (including late receipts)	26,500
d. Total of b. and c. with 8,000 duplicates removed	30,000
e. Number of reports received from U.S. cooperating ships by radio, but not by mail	7,500
f. Number of reports received from U.S. cooperating ships by mail, but not by radio	22,500

*About 11 percent of the total.

It is easy to see that 65 percent of the radio reports and 85 percent of the mail reports are received no other way. Of the nonduplicated total for U.S. ships, radio contributes about 25 percent and mail about 75 percent. In the grand total for ships of all nations, there is about a 21-percent improvement realized by adding the nonduplicate U.S. mail data.

Qualitywise, about 24 percent of the radio reports and 15 percent of the mailed, keyed records contain questionable elements. About 40 percent of the reports from each source (radio and mail) are in areas defined as "data sparse;" i.e., off the major shipping lanes. It is very difficult to assess which of the obviously conflicting elements is correct; therefore, the observation is usually discarded.

What can be learned from this?

1. We need to exercise better control of logbooks. The 25-percent rate of loss appears excessive. Some of this may result from ship ID's being confused or omitted in radio reports. This is under investigation, but probably does not affect more than 5 percent of the total. Apparently, a very large number of logbooks are not being sent to NCC.

2. There is considerable room for improvement of radio totals. This probably can be achieved best through automation.

3. For climatic applications, radio provides a valuable source of data that cannot be obtained in any other way. The same, of course, can be said of mail reports, which potentially constitute 75 percent of the data base.

Any suggestions for improving the program, including taking the observation, recording it, transmitting it, and mailing it will be given serious consideration.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

Tips to the Radio Officer

Thomas H. Reppert
National Weather Service, NOAA
Silver Spring, Md.

REPORTS OF WIND AND SEA CONDITIONS WANTED

The National Weather Service Forecast Office at San Francisco would like to contact commercial fishermen or coastal ship operators who would be willing to report wind and sea conditions. Frequently, only a few ship weather reports are received from the West Coast offshore waters, and occasionally winds and sea conditions develop in excess of the forecasts.

If you are interested, please write to the National Weather Service, 660 Price Avenue, Redwood City, CA 94063.

GULF OF MEXICO OIL SPILL MESSAGE

A Special Marine Statement for Oil Spill Operations is being issued twice daily at 1230 and 0030 GMT by the National Weather Service Forecast Office at San Antonio. The statement describes the location of the oil spill resulting from the Campeche Bay blowout and the weather forecast for the recovery and containment operations along the Texas coast. NOAA Weather Radio stations in Louisiana and Texas coastal areas carry the statement in their programming.

HF-SSB FROM COAST GUARD RADIO STATION GUAM

The Coast Guard Radio Station at Guam has added two broadcasts to their high-frequency voice schedule. They will be for typhoon warnings and alerts. Time and carrier frequencies are 0730 GMT on 13113.2 KHz and 1930 GMT on 6506.4 KHz daily. If no typhoon warnings are in effect, a suitable announcement will be made.

ACKNOWLEDGMENTS

Thanks to Radio Officers John Yancho (AUSTRAL ENTENTE) and Lyman G. Hailey (WORTH) for information relative to the marine weather program.

CORRECTIONS TO WORLDWIDE MARINE WEATHER BROADCASTS (JANUARY 1979 EDITION)

Page 8
1-0010 Norfolk, VA NAM
Delete times 0800, 1700; insert 0630, 1000, 1900, and 2300.

Page 9
1-0180 New York, NY WSF
Delete station.

Page 12
1-0460 Londonderry, Northern Ireland NST
Delete station.

Page 13
1-0550 Horta, Azores CTD
Change call sign to CTH.

Page 14
1-0560 Monsanto, Portugal CTV, CTU
Change area to read "east of 20°W."

Page 15
1-0610 Rome, Italy IAR
Add frequency 17160 KHz.

Page 19
1-0770 Point Reyes, CA NMC
Delete times 0330, 1700; insert 0200, 1600.

Page 56

1-1541	Guam, Marianas Is.	NRV	
Add:	0730	13113.2	W
	1930	6506.4	W

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Hurricane Alley

Dick DeAngelis
Environmental Data and Information Service, NOAA
Washington, D.C.

Hurricane David -- A Preliminary Report

The seemingly invincible ranks of Camille, Betsy, and Donna, those infamous females of hurricane history, have been infiltrated by a male--David.

In the Caribbean, David lived up to his early billing as one of the severest storms of the century when he plowed through Dominica, Martinique, Guadeloupe, and the Dominican Republic before turning on the eastern United States (fig. 41).

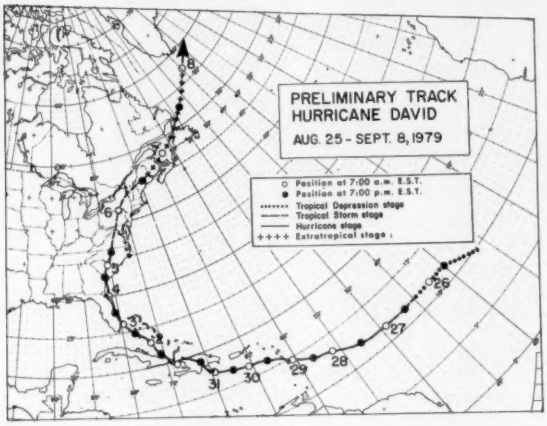


Figure 41.--Preliminary track of hurricane David.

While intense hurricanes are not new to the Lesser Antilles, neither are they commonplace. Most islanders realize that the steady trades, thunderstorms, easterly waves, and occasional tropical storms are interrupted by a really big blow. Caribbean history is filled with these storms. In 1780 "The Great Hurricane" leveled Barbados, Martinique, and Dominica; the death toll was estimated at more than 20,000. Major hurricanes have also affected these islands in 1695, 1766, and 1788. More recently in September 1963, Edith brought 110-kn winds to Fort de France, Martinique, and 6- to 10-ft tides to Barbados, Martinique, and St. Lucia. Damage was estimated at more than $45 million with 10 deaths. Inez (1966), Cleo (1964), and Donna (1960) have also battered these islands during the past 2 decades.

It had been 13 yr since Inez moved over Guadeloupe and raked the islands from Antigua to Dominica with hurricane-force winds. By August 27 it was obvious that the islands were in for a big one. At that time David's central pressure had dropped to 951 mb while his winds pumped up to 100 kn. All of this in less than 24 hr after his christening. Moving on a west-northwestward course, David continued to intensify. By early Wednesday morning (the 29th), David was just 30 mi

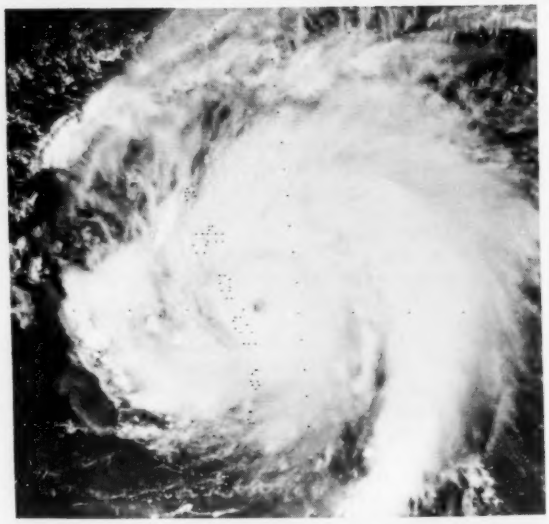


Figure 42.--Looking more like a Goliath, David's huge circulation blankets the Lesser Antilles as his eye approached the Martinique Passage on the 29th.

east of Martinique generating 120-kn winds around a 945-mb center. A few hours later (fig. 42) the pressure had dropped to 938 mb--some 40 mb lower than Edith. Hurricane-force winds extended 50 mi in all directions. Around noon David roared through the Martinique Passage between Dominica and Martinique.

Dominica took the brunt of the storm. Winds were estimated in excess of 100 kn, and rainfall up to 10 in caused extensive flooding. The capital, Roseau, was devastated, resembling an air raid. The city was without food, water, or shelter for several days. Damage was heaviest over the southwest portion of the island. Roads to and from the capital were made impassable by landslides, washouts, and fallen trees. Some shipping was possible to the port of Roseau, but the pier was partially damaged. There have been 23 reported deaths, 180 injuries. Some 60,000 people were made homeless--nearly three-fourths of the island's population. Crop damage was extensive. About three-fourths of the banana and coconut crops were destroyed.

On Martinique winds at Fort St. Louis were measured at 89 kn. Fifteen-foot waves battered the port of Fort de France. There were no deaths, 20 to 30 injuries, and 500 people left homeless. Crop damage, mainly bananas, was estimated at $50 million. On Guadeloupe the southern region of Basse Terre was hit severely. The dock at the main banana port was destroyed. Crop damage was estimated at $100 million;

the banana crop in Basse Terre was completely destroyed. No deaths, few injuries, and several hundred homeless were reported on the island. Marie Calante and Les Saintes, a small island group, were both devastated by the storm.

By Wednesday evening (the 29th) David, with 130-kn winds roaring around a 932-mb center, was threatening Puerto Rico and the Virgin Islands. The CAUSEWAY in the Guadeloupe Passage, some 70 mi north of the center, encountered 54-kn easterlies. On Thursday morning the central pressure dropped to 928.5 mb, and by noon it was down to 924 mb. Only six other North Atlantic hurricanes have had a lower measured pressure. David passed 70 to 80 mi south of Puerto Rico, remaining on a west-northwesterly course at about 10 kn. Warnings were already posted for the Dominican Republic.

While Puerto Rico did not receive the full fury of David, torrential rains, gales, and storm tides caused considerable damage. Even in San Juan trees bent, light poles toppled, and debris flew. In a suburb there was 11 in of rain in 12 hr, while Cayey reported 13 in in 24 hr. In general, the island received 4 to 10 in of rain. Much of this was due to the backlash of southeasterly winds once David had moved southwest of the island.

On Friday, August 31, 130-kn winds roared around a 929-mb pressure center. Later in the day David took this fury northwestward across the Dominican Republic coast just west of Santo Domingo. Winds in the capital city climbed above 90 kn before the wind equipment blew down. Central pressure was 926 mb as David made landfall, but he was on a collision course with the rugged mountains of Hispaniola. His Friday night trek brought tragedy and destruction to the island (fig. 43).

While the mountains of the island weakened the storm, they were also responsible for torrential rains, flash floods, and locally accelerated windspeeds. The great killer was floods. They isolated communities, swept villages away, and were mainly responsible for more than 1,000 deaths that have been estimated so far. The port of Santo Domingo was closed for several days to permit soundings in the channels. At the Sea-Land terminal in Rio Haina a rail-mounted container crane collapsed. Most roads were heavily damaged as were the cities of Jarabacoa, San Cristobal, and Bani. In the mountain village of Padre las Casas several hundred people were killed when a church and school they were using as a haven was swept away by a rampaging river. Crop damage was severe and widespread. Almost 70 percent of the crops were destroyed with da-

Figure 43.--Santo Domingo, oldest national capital in the Western Hemisphere, fell victim to David as witnessed along this battered boulevard only yards from the oceanfront. Wide World Photo.

mage estimated at $350 million.

The last severe hurricanes to affect the Dominican Republic and Haiti were Beulah in September 1967 and Inez a year earlier. Both of these storms ripped through the Lesser Antilles and across the Barahona Peninsula. Beulah reached a peak of 120 kn, while the winds in Inez were estimated at 130 to 150 kn just before she reached the Dominican Republic. As devastating as these storms were, they take a back seat to Flora (October 1963). Her winds were estimated at 120 kn around a 930-mb central pressure. Maximum rainfall amounts exceeded 75 in. Flora was responsible for 5,000 deaths in Haiti and the Dominican Republic, with damage estimated at nearly $200 million. Inez caused $32 million damage and about 850 deaths, while Beulah's figures were considerably lower. At this time, it is estimated that David is responsible for 1,000 deaths and nearly $1 billion in damage--most of this in the Dominican Republic.

On the morning of September 1 a weakened, somewhat disorganized David showed his eye along the north coast of Haiti. His maximum winds were barely hurricane force. He remained in this state as he crossed the Windward Passage and the eastern tip of Cuba that afternoon. Once over more open waters, David began to reintensify as he headed northwestward. By the 2d 80-kn winds roared around his 980-mb center, which was skirting the western Bahamas. During the afternoon Andros Island reported 60- to 70-kn winds shortly before the eye appeared. Up to 8 in of rainfall was reported in the Bahamas. The GEN SWIERCZEWSKI encountered 50-kn winds as she sailed through the Straits of Florida.

David's pressure fell to 962 mb and winds climbed to 90 kn as he approached southern Florida early on the 3d (Labor Day). A slight northward shift brought David's center about 50 mi east of Miami, where the beaches were buffeted by gale-force winds (fig. 44). Wind gusts of 60 to 70 kn were reported along Florida's east coast as David moved northward. This was accompanied by heavy surf and 2 to 5 in of rain. By the evening David's center was on the beach just south of Melbourne. He remained close enough to water to maintain hurricane strength. West Palm Beach reported 50-kn winds with gusts to 65 kn before the power failed; gusts were estimated to have reached 74 kn.

After a short journey over open water on Tuesday (the 4th), David, sporting 80-kn winds, roared across St. Catherine Sound to finally come ashore just south of Savannah Beach, Ga. Savannah recorded 50-kn winds with gusts to 59 kn and a low pressure of 970 mb. Tides were generally 3 ft above normal. Two French students were drowned in the heavy surf off Jekyll Island. To the north gusts along the coast ranged from 50 to 60 kn. Charleston, S.C., reported 49-kn gusts. Tides ran 2 to 5 ft above normal. Several tornadoes were reported between Charleston and Myrtle Beach. Rainfall was heavy in some areas. Savanna received 6 to 7 in, and there were reports of 9 to 10 in of rain in interior South Carolina. Elsewhere, amounts of 2 to 5 in were common. Flooding was light to moderate. However, in North Carolina major flooding was reported on the Lumber River.

On his journey northward as a tropical storm, David continued to spread squalls, with heavy rains and gusty winds, and some tornadoes east and northeast of his center. He made his way through the Carolinas on the 5th. Raleigh and Greensboro, N.C., reported gusts to 31 kn. To the east Elizabeth City was drenched by 8.52 in of rain. Along the coast there was only some minor flooding and beach erosion. By Wednesday night the tropical storm moved through Virginia, Maryland, and into central Pennsylvania. Tornadoes touched down in Maryland, southern and northern Virginia, Pennsylvania, Delaware, and New Jersey. Rainfall amounts ranged up to 8 in, while winds gusted from 30 to 40 kn. Wilmington, Del., recorded a 46-kn gust, while winds at Richmond gusted to 39 kn. Wind and rain were responsible for widespread power outages all along the eastern seaboard. In the New York metropolitan area 2.5 million people were without electricity.

Figure 44.--Lonely beachcomber strolls AIA in Fort Lauderdale shortly after David paid his respects. Wide World Photo.

David finally turned northeastward upon crossing the New York line on Thursday morning (6th), near Binghampton. Binghampton had gusts to 30 kn with less than 2 in of rain. As David accelerated through New England, he began to turn extratropical. By late on the 7th he was through New Brunswick, Newfoundland, and out into the open North Atlantic.

It is still too early to evaluate the damage David caused. First rough estimates are around $1.5 billion, which includes $1 billion in the Dominican Republic. These figures usually come down. The death toll in the Dominican Republic may reach 1,200. Twenty-three deaths were reported on Dominica, while Puerto Rico has counted nine with 30 people missing. The estimate in the United States is 16.

SOUTHERN HEMISPHERE
MAY AND JUNE 1979

No tropical cyclones formed during these months in the Southern Hemisphere. This is not unusual. Since 1965 there have been four tropical cyclones in May, three of which became hurricanes, in the Australia-South Pacific region. In the South Indian Ocean four tropical storms have formed in May since 1965. There has been no activity in June recorded in either basin.

ADDITION TO
SOUTH INDIAN OCEAN - APRIL 1979

Kevin actually formed in April and will be counted as such. However, the warnings did not begin until May 4. He developed far to the east of the Diego Garcia Islands on April 28 (fig. 45) and attained tropical-storm strength on May 4 after meandering westward. The following day winds reached 50 kn near his center, and by the 7th they were estimated at 60 kn. At this time Kevin began to slow and turn westward. He also began to weaken as he moved over cooler waters through a midlevel ridge of high pressure.

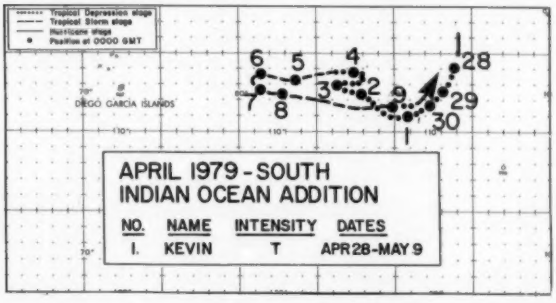

Tropical Depression stage
Tropical Storm stage
Hurricane stage
Position at 0000 GMT
DIEGO GARCIA ISLANDS
APRIL 1979 - SOUTH INDIAN OCEAN ADDITION
NO. NAME INTENSITY DATES
I. KEVIN T APR 28-MAY 9

Figure 45.--Track of April tropical storm, South Indian Ocean.

NORTH INDIAN OCEAN
MAY AND JUNE 1979

A May hurricane developed in the Bay of Bengal, while in June a tropical storm roamed the Arabian Sea (fig. 46).

The hurricane, generating winds up to 95 kn, barged ashore along the southeast coast of India on May 11. The storm was responsible for more than 500 deaths. Worst hit was Prakasam district of Andhra Pradesh State, where fatalities totaled 449. About 100,000 cattle also perished.

Nine pilgrims including two women were reported dead from overexposure and cold after they were caught in a hailstorm while climbing to a Hindu temple on a mountainside southwest of Madras.

This area was racked by a November hurricane in 1977. That storm was responsible for 14,000 lives. The toll was blamed on inadequate warnings and disregard of the warnings that were issued. This time authorities were better prepared and people listened. More than 300,000 people were evacuated in advance, including many who had lost their homes just 18 mo before. Reports indicate that the damage may be as great from this storm as it was from the last.

The storm originated between Sri Lanka and the Nicobar Islands on the 5th. By the 8th it was a hurricane and heading northward. The following day it turned toward the northwest (fig. 47). Before it moved inland the storm was responsible for sinking the UNITED VANGUARD. The 31 crewmembers and their families were rescued.

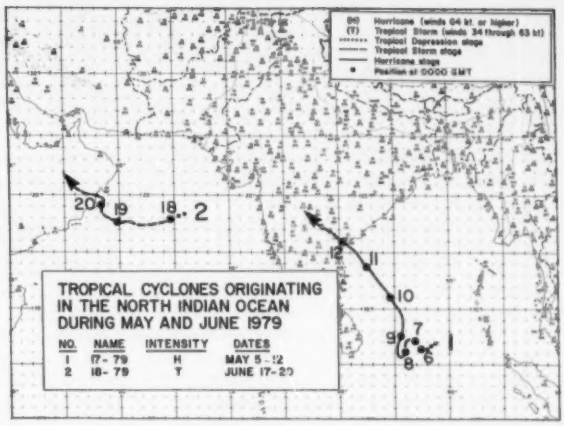

Hurricane (winds 64 kt. or higher)
Tropical Storm (winds 34 through 63 kt)
Tropical Depression stage
Tropical Storm stage
Hurricane stage
Position at 0000 GMT
TROPICAL CYCLONES ORIGINATING IN THE NORTH INDIAN OCEAN DURING MAY AND JUNE 1979
NO. NAME INTENSITY DATES
1 17-79 H MAY 5-12
2 18-79 T JUNE 17-20

Figure 46.--Tracks of May and June tropical cyclones, North Indian Ocean.

The tropical storm in the Arabian Sea developed on June 17. It headed westward. Maximum winds climbed to 50 kn as the storm approached the coasts of Muscat and Oman. Gales, associated with a strong southwest monsoon flow, extended a considerable distance east and south of the storm. The storm moved ashore just south of Al Khaluf. Masirah, nearby, has an average June rainfall of 0.1 in, with a record of 0.4 in. No reports of rainfall from this storm have been received.

Figure 47.--The hurricane moves ashore just south of the Mouths of the Godavari on the 12th.

On the Editor's Desk

VESSEL TRAFFIC SERVICE RECOMMENDED FOR CHESAPEAKE BAY ENTRANCE

The National Transportation Safety Board recommended on August 2, 1979, that the U.S. Coast Guard establish a mandatory, manned Vessel Traffic Service for tracking and controlling shipping in the Chesapeake Bay entrance area.

The Board made its recommendation to the Coast Guard in its report on one of three collisions. It involved the outbound Greek cargo ship STAR LIGHT and the inbound Navy troopship FRANCIS MARION last March 4. The two 560-ft ships collided in dense fog. There were no fatalities, but there were three injuries aboard the Navy ship. However, damage to both ships was estimated at $3.5 million (fig. 48).

The Safety Board determined the probable cause of the accident was "the failure of the master of the STAR LIGHT to comply with the starboard-to-starboard passing agreement that was made with the FRANCIS MARION" in a radiotelephone conversation. Contributing factors, the Board held, were "the failure of the STAR LIGHT's navigation watch to plot the radar data" on ships it was approaching and the "relatively high closing speeds of both vessels."

Joint investigation by the Safety Board and the Coast Guard showed that both ships had sounded and heard fog signals when they were about 1,000 yd apart. The Navy ship's captain immediately ordered that its engine be stopped, but the Greek master held his course and speed. The bow of the Greek ship struck the starboard side of the Navy vessel.

The Board concluded that the existing marine traffic system at the Chesapeake Bay entrance--placing all responsibility for vessel separation on ships' masters or pilots--"does not provide adequate collision avoidance protection."

The Board recommended a Vessel Traffic Service (VTS) be established at the entrance of Chesapeake Bay. An active manned VTS with adequate surveillance (usually radar) would have advised each vessel of the position, speed, course, and intended action of the other in the congested Bay entrance and could have prevented the March 4 collision as well as others in October and December 1978.

The Safety Board also urged the Coast Guard to (1) record and preserve radiotelephone navigation messages in the Bay entrance as an aid to accident investigation; (2) relocate the demarcation line separating

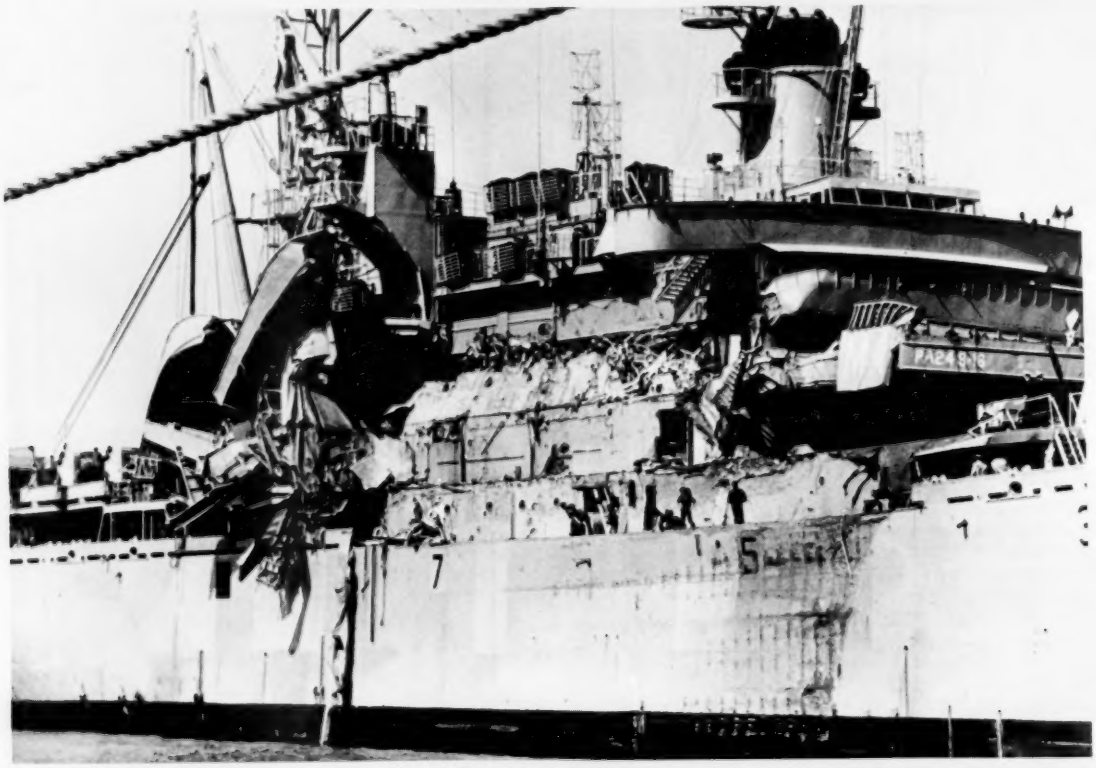


Figure 48.--Damage to the FRANCIS MARION after a collision with the STAR LIGHT in heavy fog in the Chesapeake Bay. Wide World Photo.

the inland and international rules of the road away from the precautionary area at the Bay entrance; and (3) establish an additional designated area, away from where pilots may embark and disembark vessels in good weather.

Figure 49. -- Three large freighters were grounded high and dry by the high surge and waves from Camille as she moved ashore. The SILVER HAWK and HULDA are shown with the ALAMO VICTORY hidden from view.

HURRICANE CAMILLE STRUCK 10 YR AGO

Ten years ago on August 17, 1969, one of the most vicious hurricanes in the recorded history of the North Atlantic roared out of the Gulf of Mexico east of New Orleans, beginning a 3-day battering of Louisiana, Mississippi, Tennessee, Kentucky, and Virginia.

By the time remnants of hurricane Camille moved into the Atlantic off Virginia, its winds, storm surge, and rainfall had killed some 250 persons and caused damage in excess of $1 billion. Camille packed a triple threat; 190 mi/h winds (165 kn) at the time of landfall, a 20- to 25-ft storm surge topped by 15-ft waves (fig. 49), and torrential rains that caused deadly flash flooding in Virginia.

Ample advance warning was given regarding where Camille would come ashore; warning almost equal to that available today through improved storm-tracking technology. But warning of an impending hurricane is only half the story of survival, according to NOAA Administrator Richard A. Frank. The other half is being able to respond quickly and effectively. Too many coastal cities even today are ill prepared for an adequate response to such a major assault and, accordingly, risk the lives of residents and visitors. It is just a matter of time before a dangerous storm strikes an area unprepared to cope with the hurricane's most deadly killer--the storm surge, which brings rapidly rising ocean water inland, cuts off escape routes and threatens thousands with drowning.

Camille could be the forerunner of a hurricane even more devastating to our increasingly populous coastal areas. Every city in every state along the Gulf and Atlantic coasts should be prepared to meet a Camille.

NOAA is doing its utmost to encourage preparedness and assist communities in developing programs. Storm evacuation maps have been prepared, aiding local officials in developing their plans, including evacuation routes, areas, and shelters. Storm-surge models are being developed that will enable planners to determine the surge effects in complex coastal bays and estuaries from model hurricanes. Research is underway to improve prediction of hurricane rainfall, the storm's major threat after it moves inland.

Another element crucial to survival from hurricane effects is public appreciation and awareness of the dangers lurking in these storms. During Camille, authorities evacuated 81,000 persons from threatened coastal areas of Mississippi and Louisiana. But others--the curious, the unbelievers, and the survivors of past storms--ignored all warnings. For 144 men, women and children the winds and storm-tossed waters of Camille spelled death amidst flying debris and collapsing buildings (fig. 50).

Camille's existence as a hurricane ended in mid-Mississippi about 12 hr after the storm came ashore. But its career as a killer was only at midpoint. On August 18 and 19 the storm weakened steadily to a tropical depression as it passed through Tennessee and Kentucky. Late on the 19th, however, remnants of the storm began deluging the mountains of West Virginia and Virginia with rainfalls of 12 to 14 in during an 8-hr period.

The upper and middle reaches of the James River Basin in western Virginia rose rapidly and spilled over their banks as the day progressed, with the storm moving eastward across the State, dumping rains of 4 in or more. Many communities experienced two floods: a flash flood from their local streams and a second flood later as mainstream floodwaters arrived. The suddenness of the onslaught in mainstream headwater areas to a large extent precluded any effective community preparedness actions. More than 100 persons lost their lives in treacherous flash-flood waters.

Figure 50.--View of an apartment house on the Gulf coast of Mississippi, before, and of only the swimming pool, after, the passage of hurricane Camille. Photo courtesy of Chauncey Hinman.

Two days later the remnants of Camille merged with a frontal system off Newfoundland and lost their identity. But the mangled coastline of Mississippi, the Louisiana delta, and the mountains of western Virginia long bore the evidence of Camille, one of the most savage hurricanes in recorded history.

Note: Devastating hurricane Frederic struck the same area September 12, 1979, 10 yr and 3 weeks later. Only eight deaths have been reported, but it is believed that damage will run over $1 billion.

TIDAL WAVE LEVELS FOUR INDONESIAN VILLAGES

A tidal wave struck the Indonesian Sunda Islands during the night of July 18 and 19. The cause of the tidal wave was said to be a landslide on Mount Werung on the Lomblen Island. The wave reached 30 ft and swept up to 1,500 ft inland. The death toll was set at 539. Villagers were caught asleep when the wave hit. There were only 171 survivors in the villages.

ST. LAWRENCE SEAWAY CLOSING

United States and Canadian Seaway authorities again have issued special regulations to cover the season closing in December. The policies are similar to those instituted in 1978, aimed at preventing a late and post-season rush of salties through the locks. This year, a "closing period" beginning December 1 and ending with the last vessel transit of the Montreal-Lake Ontario section has been designated. The latest date on which vessels can report to Cap St. Michel for final down-bound transit of the International Section will be December 15; vessels which miss this call-in point deadline will be allowed to transit the locks only if conditions are good and will be charged a late fee of $20,000 per day up to a maximum of $80,000. Upbound vessels heading for the Upper Lakes must call in at Cap St. Michel by December 4 in order to be allowed to pass back out the waterway. Also included are special deadlines for low-powered vessels.

YELLOWSTONE-IBN BATOUTA COLLISION EVALUATION

The failure of the captain of the U.S. freighter YELLOWSTONE to make proper use of the ship's radar caused a collision with an Algerian freighter in dense fog 14 mi southeast of Gibraltar, according to the National Transportation Safety Board. Five persons died on June 12, 1978, when the IBN BATOUTA rammed 30 ft into the portside of the 500-ft YELLOWSTONE, which was enroute from Baie Comeau, Canada, to Tunis, Tunisia. The ships were separated the next day, and the YELLOWSTONE flooded and sank in 600 fathoms of water.

The Safety Board concluded that the captain of the YELLOWSTONE did not slow to a safe speed when the vessel entered the dense fog, and that he turned his vessel across the path of the 368-ft IBN BATOUTA without knowing its course, speed, closest point of approach, and relative movement in advance of the maneuver to avoid the collision. The captain waited too long before taking evasive action, and in his desperation to avoid the oncoming target he unknowingly made the situation worse.

Although the officers on watch on each of the vessels knew in advance that they were in a head-on situation and a possible close passage, neither vessel reduced its speed below 15 kn. Further, the watch officers failed to make a relative motion plot with the radar to determine the other vessel's course, speed, and closest point of approach. The crew of the IBN BATOUTA failed to take evasive action to avoid a close-quarters situation, failed to sound fog signals, or have the ship's engines ready to maneuver.

In its official determination, the Board said the probable cause of the accident was: "The failure of the master of the YELLOWSTONE to properly use the ship's radar, which led to his crossing the bow of the IBN BATOUTA in an effort to prevent a collision in a close-quarters situation. Contributing to this accident was the excessive speed of both vessels in a dense fog; their failure to avoid a close-quarters situation; and the failure of the IBN BATOUTA to sound fog signals, to have the engine ready for immediate maneuver, and to use the bridge-to-bridge radiotelephone to establish a safe passing maneuver."

The Board said each ship had installed a VHF bridge-to-bridge radiotelephone. When the vessels were within 2 mi of each other, the captain of the YELLOWSTONE tried to contact the IBN BATOUTA to inform him of his intentions, but he got no response.

As a result of its investigation, the Board made a series of recommendations to the U.S. Coast Guard, including these:

- require more frequent examinations of deck officers to keep them proficient in the techniques of solving radar target problems.

- propose to the Intergovernmental Maritime Consultative Organization that a study be initiated to determine the need for establishing an effective Vessel Traffic Service facility at the east end of the Strait of Gibraltar to improve safety in the heavily-trafficked area.

- require periodic gauging of bulkheads on bulkcarriers that are more than 15 yr old. In particular, the lower portions of bulkheads in cargo holds, bilge wells, saltwater ballast tanks, and machinery spaces should be gauged for timely renewal due to corrosion and wastage.

WATERSPOUT

This photograph (fig. 51) of a waterspout was taken on August 26, 1979, by 2d Mate Henry M. Lopez of the PENNY while approaching Southwest Pass Pilot Station. The temperature was 86°F, barometer 30.01, and wind easterly 2-3.

Figure 51.--Alert camera work of the 2d Mate of the PENNY caught this waterspout at 1610 August 26, 1979, off Southwest Pass.

BAD WINTER FOR INSURERS

One of the worst winters in the Northern Hemisphere in 20 yr resulted in heavy shipping losses and serious casualties. Final figures are not yet compiled, but if the present rate of serious accidents continues, the cost probably will exceed the high total for 1978 of over $545 million.

The western European coastline took a mauling during the winter, and there was heavy coastal flooding and damage in parts of the United Kingdom because of

the fierce winter gales and heavy seas. It was also the first time for some years that the Norwegian coast in the Skagerrak froze. The Kattegat also iced over for some time.

Major hull casualty statistics for the first 6 mo of the year show 24 settled losses by the world's marine insurance markets at a total value of $145 million. The 24 losses were 10 general cargo, 3 dredgers, 4 tankers, 2 bulk oil/ore carriers, 1 fishing, 1 supply, 2 jack-up drilling ships, and 1 cruise liner. Gross tonnage totals 364,558. These figures relate only to ships with an insured hull and machinery value in excess of $1,125,000 and are based on the sterling equivalent on the date of casualty.

One of the first large settled constructive total losses for 1979 was the $14.2 million 61,766-ton French tanker BETELGEUSE, which blew apart while unloading crude oil at an oil terminal in Bantry Bay, Eire, on January 8. Fifty people were killed, and the ensuing fire burnt for 24 hr. The tanker broke in two. Gulf Oil estimated that it would cost $34 million to repair and rebuild the two-berth loading terminal.

Another heavy loss occurred on March 30 when the Italian cruise liner ANGELINA LAURO caught fire in dock at St. Thomas, V.I., while she was on a Caribbean cruise. None of the passengers were injured in the blaze, which was eventually extinguished about April 5. The vessel was valued at $13.5 million and is a constructive total loss. A salvage firm has been contracted to remove the sunken ship from the harbor.

The heaviest monetary loss for the first half of the year occurred on April 21, when an offshore gas well blew out in the Gulf of Mexico off Louisiana. The $23 million Panamanian jack-up drill platform SALENERGY II was destroyed by fire and collapsed onto the well. Forty workers had already been evacuated, and there were no injuries.

A week later the Liberian-registered GINO sank after a collision off Brittany. Valued at $13 million, she was carrying 32,000 tons of carbon black and has been settled for a total loss.

The largest vessel lost so far this year is the 91,963-ton Liberian steam tanker ATLAS TITAN. She is a constructive total loss after an explosion and fire. Her tanks were being cleaned near Setubal on May 27 after she had discharged a cargo of naphtha. The tanker was valued at $14.9 million.

FISHING VESSEL ABUNDANCE BURNS

The following photograph and narrative were sent by Rosemary Porter of the Tundra Drums of Bethel, Alaska.

A fire on the night of June 28 completely destroyed the fishing vessel ABUNDANCE (fig. 52) while it was drydocked for propeller repairs at the Platinum spit. No loss of life or injuries were reported. Southeasterly winds gusting to 30 mi/h fanned the blaze at the onset of the fire, threatening the bulk fuel storage tanks located near the ship on the spit.

Crewmembers observed smoke issuing from the engineroom at about 10:00 p.m. The chief engineer of the 147-ft vessel went to investigate the fire in the engineroom, but was driven back by the heavy smoke. He reported that the engineroom's fire extinguishing system did go off, but failed to extinguish the fire. The captain of the vessel declared the fire out of control about a half hour later and called for the crew to abandon ship. The fire spread rapidly from the engineroom forward and eventually consumed the entire ship.

Figure 52.--The burning hulk of the fishing vessel ABUNDANCE. Tundra Drums photo by John Burrows.

Several attempts were made to board the vessel after the fire started, but the decks were found to be too hot. A further attempt was made to put a seawater pump onboard to control the blaze, but the fire below deck, which was being fueled by 7,000 gal of diesel fuel, was impossible to contain. During the evening all four fuel tanks ruptured with resulting large plumes of smoke and fire which engulfed the superstructure of the ship, while hydraulic pumps and pumplines continued to explode.

A change in wind direction removed immediate danger to the fuel tanks on the spit. Burning embers and flames were blown off to the southwest instead of toward the tanks.

The ship was a converted U.S. Navy mine sweeper built in 1947. The vessel was made completely of wood and demagnetized for mine sweeping in the Pacific after World War II.

NOAA TESTS DEVICE AS OIL-SPILL DETECTOR

A sensitive infrared scanner which can "see" an oil spill in the dark is being tested aboard a research jet this summer to determine its effectiveness in detecting oil thickness, extent, and type during various weather conditions. It could be an important tool for assessing damage from an oil spill in partly cloudy, foggy, or hazy weather.

Dr. Peter Kuhn, a meteorologist at NOAA's Atmospheric Physics and Chemistry Laboratory in Boulder, Colo., is flying the instrument aboard a NASA Lear jet over a small permanent oil slick in California's Santa Barbara Channel. Twice-weekly flights from NASA's Ames Research Center will continue through September 30.

The device, which weighs about 80 lb, is equipped with a variety of infrared filters to cut through very thin cirrus clouds, pollution or haze, and very thin fog. Mounted in the belly of the Lear jet, the radiometer is aimed straight downward and rotates a full 90 degrees from side to side as the infrared "eye" of the instrument senses the heat emitted by a swath of ocean several miles wide.

The potential value of the infrared system lies in the difference in temperature between the ocean and the oil slick, which the eye or camera cannot detect. Thermal differences provide a much greater range of identification than the visible does. The radiometer converts the heat-sensitive signals from the ocean surface into black and white or enhanced color visual maps. Various shades of gray or color hues are calibrated against different oil types, thicknesses, and temperatures to portray oil extent, possible thickness, type, and age. A volatile oil such as fuel oil No. 2 can show colder temperatures than the surrounding ocean. Other, less volatile oils such as bunker C crude show warmer temperatures than the surrounding ocean due to strong absorption from solar radiation. As the oil ages, the differences in temperature decrease; the oil gets thinner and closer to oceanic temperatures.

NOAA-6 LAUNCHED

A new environmental monitoring satellite (NOAA-6) (fig. 53) joined its twin in space on June 27, 1979, completing an information-gathering system vital to national weather forecasting. It was launched into near-polar orbit by NASA from the Western Test Range near Lompoc, Calif. NASA's Goddard Space Flight Center in Greenbelt, Md., has management responsibility until the spacecraft and its systems are fully checked out after reaching its 513-mi (833 km) altitude orbit.

An identical satellite, TIROS-N, launched by NASA in October 1978, has been providing highly accurate meteorological information on a worldwide basis. Its orbital characteristics are such, however, that a second satellite is required to permit continuous coverage of the world's weather for the National Meteorological Center's (NMC) analysis and forecast cycles.

Data from NOAA-6 primarily will be used by the NMC in Suitland, Md., to improve numerical weather forecasts, the basis for most National Weather Service predictions. It will fill in data-void areas, especially over the oceans, and by crossing the Equator 6 hr after TIROS-N, will in effect double the amount of data available to NMC.

Computer-prepared forecasts from the Center, based on millions of pieces of information, are distributed twice daily to National Weather Service offices across the country and are fundamental to most local and regional weather forecasts. Additionally, the Cen-

Figure 53.--NOAA-6 completes a worldwide system. With TIROS-N, an identical satellite, continuous meteorological coverage is assured.

ter prepares the longer-range forecasts for marine, agricultural, and aviation interests.

Data and space pictures collected by NOAA-6 and TIROS-N also are of value to oceanographers, hydrologists, and other scientists. Improved and expanded environmental information gathered by the spacecraft could mean more exact determination of sea surface temperatures and more precise snow cover, snowmelt, and rainfall data. Information of this kind is also important to fishing and marine shipping interests, water resource managers, and those concerned with flood forecasting.

TIROS-N has provided more accurate information on high-energy solar radiation levels above the atmosphere of concern to space missions, high-altitude commercial aircraft flights, long-range communications, and electrical power distribution networks.

Direct broadcast of pictures from both NOAA-6 and TIROS-N will provide a look at local weather from space for receiving stations in more than 120 countries around the world. These stations will receive two visible images and four infrared images daily as the satellites pass within range of their antennae.

During the remainder of this year the twin spacecraft will be key elements in the Global Weather Experiment, the largest international scientific experiment ever held. Scientists from more than 140 participating nations are seeking to gauge the practical limits of weather forecasting and to design a world weather observing system to achieve them. TIROS-N and NOAA-6 are especially important in providing information from remote locations, where traditional weather-gathering methods cannot be used conveniently.

NOAA plans to keep two spacecraft of the TIROS-N series in orbit at all times through 1985. With a life expectancy of 2 yr, it is projected that eight such satellites will be required. The satellites are built by RCA Astro Electronics, Princeton, N.J., for about $15 million each.

Instruments on board TIROS-N and NOAA-6 can measure temperature and humidity in the Earth's atmosphere, surface temperatures, surface and cloud cover, water-ice-moisture boundaries, and proton and electron flux near the Earth. They can receive, process, and retransmit data from free-floating balloons, buoys, and remote automatic stations distributed around the globe and can also track such stations which are in motion.

The last three spacecraft of the series will carry search-and-rescue instruments as proof-of-concept for a system that could aid in locating lost aircraft and ships.

LETTERS TO THE EDITOR

CERTIFICATE OF MEMBERSHIP PRESENTATION

A copy of the letter below was received from Donald Olson, NWS Port Meteorological Officer, Seattle, Wash.

5 July 1979

E. E. Wilson, Editor
Mariners Weather Log
Environmental Data and Information Service

D. L. Olson
Port Meteorological Office, Seattle

Certificate of Membership Presentation

A certificate of membership in the cooperative ship observing program was presented to Captain Armando M. Robles, Master of the M/V GEMINI, on June 19, 1979 (fig. 54).

The M/V GEMINI (fig. 55) was first recruited into the program on their first voyage to the Pacific Northwest in March 1978. The Deck Officers began the observation program on their first voyage to Japan and the ship was officially entered into the program later in the year. Captain Robles, the Deck Officers and the Radio Officer have been doing excellent in the ship observing program.

The M/V GEMINI will be calling at Pacific Northwest ports for the next several years in the logging trade to Japan. Captain Robles has commended the National Weather Service for the excellent high-seas forecast products provided to all shipping in the North Pacific.

Ship's Vital Statistics:		
	LOA	565 feet
	DWT	27,687 tons
	Speed	15.0 knots
	Call sign	ELIU
	Owner	Neptune Enterprise Shipping, Inc. Liberia Y.S. Line Charter

Captain Robles has been going to sea for the past 26 years since graduation from the Philippine Maritime Academy in 1953.

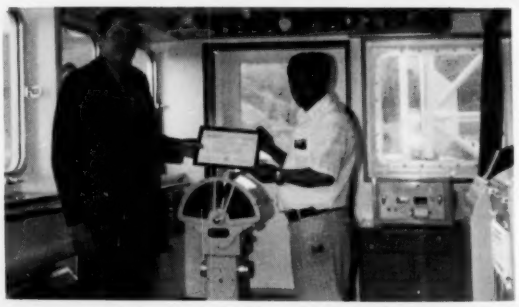


Figure 54.--Captain Robles receives his certificate.

Figure 55.--The GEMINI at dockside.

MARINE WEATHER REVIEW

The Smooth Log (complete with cyclone tracks, climatological data from U.S. Ocean Buoys, and gale and wave tables) is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The Rough Log is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both Smooth and Rough Logs, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

March and April 1979

SMOOTH LOG, MARCH 1979--The climatological tracks for storms this month primarily are from over the Great Lakes to up the St. Lawrence River to Greenland, where they split to the north and east. A second track is from the U.S. East Coast northeastward. There are secondary tracks across northern Europe and the Mediterranean. The actual tracks this month were similar. The low-pressure centers from the Great Lakes generally tracked into Baffin Bay with another center forming near the southeast coast of Greenland and tracking east to northeastward. More than the usual number of East Coast storms turned northward toward the Labrador Sea. The secondary tracks out of the eastern ocean combined into a primary track across central Europe.

There were major differences between the climatic and actual mean monthly pressure patterns. The one that had the most effect on the shipping lanes was the location of the Icelandic Low. This month it was 994 mb between Iceland and Norway near 67°N, 02°E. It is normally 1005 mb near 58°W, 40°W, off Kap Farvel with a companion 1007-mb LOW near the actual location this month. The Azores High was 1025 mb near 37°N, 27°W, about 800 mi northeast of its normal 1020-mb position. There was an anomalous closed 1021-mb High off the U.S. southeast coast. The Arctic High over the Arctic Ocean at 1041 mb was 18 mb higher than the climatic normal. This did not directly affect the weather over the North Atlantic, but indirectly it had to have a great influence.

With such large differences in central pressures and locations, there were bound to be large anomalies. The Icelandic Low produced a minus 15-mb center off Norway. The displacement of the Low and the Azores High combined to produce a plus 16-mb anomaly center near 48°N, 40°W. The Arctic High produced a plus 21-mb center that stretched deep into Siberia.

At 700 mb the primary Low center was normally located near Baffin Island only 61 m deeper than normal. The surface Low over the Norwegian Sea was reflected by a secondary Low near 69°N, 05°W. There were two long-wave troughs, one off the North American coast and another over the west coast of Europe. The midocean was dominated by a ridge. The anomaly centers were collocated with their surface counterparts.

Extratropical Cyclones--This LOW center formed on the 4th off the southeast coast of Greenland in a trough of the general cyclonic circulation. There was very little change in the westerly flow that had prevailed for several days. A Soviet ship west of OWS Charlie had 45-kn winds, while Charlie had 26-ft swells. By 1200 on the 6th the storm had moved to 63°N, 05°W, at 970 mb. The ocean weather stations had winds of about 40 kn and seas and swells up to 25 ft. A Norwegian ship on the North Sea had winds over 50 kn, and nearby a Russian ship reported 30-ft seas and 38-ft swells. The storm was running northeastward along the Norwegian coast late in the day and passed almost directly over OWS Mike. At 0000 on the 7th Mike had 40-kn winds and 20-ft seas. On the 8th the storm continued past Nordkapp.

This was another of those storms that split on the southern tip of Greenland. The original LOW came across Hudson Bay and at 1200 on the 6th was against the southwest coast of Greenland. The storm split by the 7th, with one center moving northward up the west coast and the other center forming on the southeast coast. This new center was 978 mb. The Icelandic fishing fleet reported winds up to 50 kn. A buoy off the southwest coast of Iceland measured 40-kn winds.

At 1200 on the 8th the tightly wound storm was 956 mb over Iceland. A U.S. Navy ship north of Ireland had 58-kn winds. A Canadian ship near 56°N, 27°W, also had 60-kn winds. Lima reported 23-ft swells. On the 9th Lima measured 55-kn winds and swells to 33 ft. The reporting platforms in the North Sea were battered by winds up to 45 kn and seas up to 25 ft. The IRVING ARCTIC (50°N, 04°W) reported 30-ft seas and 49-ft swells. On the 10th the storm circled northwestward into the Greenland Sea and returned to the Greenland coast. The Scoresby Sound station measured 40-kn freezing winds.

A frontal wave moved over the Maritime Provinces on the 8th. On the 9th another wave formed on the front farther east. The STUTTGART EXPRESS (49°N, 40°W) was running into 44-kn winds and 23-ft swells south of the wave. On the 10th the storm turned northward in response to lowering pressure to the north. The ATLANTIC SAGA (50°N, 30°W) had rain driven by 50-kn winds with 21-ft seas. On the 0000 chart of the 11th, two LOWs had combined into one and the storm had moved eastward. The pressure was 962 mb at 1200. Lima and ships in that area were again catching the brunt of the storm with winds over 40 kn and seas of 25 ft or over. The RANGA had 60-kn winds south of

Iceland. A German ship nearby had 50 kn and 23 ft. The LOW was over the North Sea on the 12th bringing winds in the 40-kn range. The storm moved over the Continent on the 13th.

This storm formed over Maine at the point of occlusion of a front stretching south out of Canada. As the LOW moved northward and the front eastward, the gradient on the east side tightened against a HIGH over the central ocean. At 0000 on the 12th the TREIN MAERSK (39°N, 64°W) had 45-kn winds from the south and 18-ft seas. At 1200 the 958-mb LOW was north of Anticosti Island. The Blue Hill Observatory measured winds of 51 mi/h, while the Mt. Washington Observatory, N.H., at over 6,000 ft measured 107 mi/h. The WILD CURLEW (40°N, 63°W) reported 50-kn winds and 33-ft seas, while the IMPERIAL ACADIA (46°N, 59°W) radioed 50-kn winds, but neglected the waves.

By midday on the 13th the LOW had reached Frobisher Bay. The ATLANTIC SAGA was southeast of Sable Island with 52-kn northwesterly winds and 30-ft seas. On the 14th the front swept by the HOFSJOKULL (52-kn winds) and OWS Charlie (21-ft waves). The LOW died over Canada, and another formed on the front east of Kap Farvel.

This LOW moved over the Great Lakes on the 13th and 14th. Its eastern circulation was off the coast on the 14th with winds up to 40 kn. On the 15th the BARWA (37°N, 64°W) was in southerly 58-kn winds. The TACTICIAN at 33°N, 66°W, verified the 58-kn wind report later in the day.

At 0000 on the 16th the 994-mb storm entered the Labrador Sea. The BARWA was now at 40°N, 67°W, with 64-kn winds. The seas were only 16 ft. The HIGH was blocking eastward movement of the LOW, the front jumped northward, and frontal waves were moving up the front. The LOW disappeared over Baffin Bay, and the gradient along the front relaxed.

Monster of the Month--These storm reports were involved with a series of small LOWs that formed, rotated around a common center, and dissipated. It started with one of the frontal waves from the previous storm. It brought measured 60-kn northerly winds to the EL PASO ARZEW (36°N, 55°W) at 2200 on the 16th. The seas were 20 ft. It also brought 45-kn winds to a Soviet ship near 40°N, 45°W, on the 17th. As that circulation moved northwestward, another formed to the southeast on the 18th. The YTXT near 32°N, 53°W, had 60-kn winds. The LNG CHALLENGER (36°N, 70°W) discovered 53-kn northwesterly winds. The BARWA was still in the area (45°N, 43°W) with 74-kn winds out of the southeast and 36-ft seas.

There were three separate small LOWs of about 998 mb on the 19th with centers located from 46° to 35°N and 51° to 61°W. The CGC TAMAROA had 40-kn winds and 30-ft swell waves near 34°N, 67°W. The IMPERIAL ACADIA and another Canadian ship had 60- and 78-kn winds in the vicinity of 47°N, 60°W. The GREEN HARBOUR was near the center of one of the LOWs at 35°N, 59°W, with winds of 50 kn and seas of 16 ft.

These LOWs had very shallow upper air support--a trough at 700 mb--but between the 17th and 19th a LOW at 700 mb plunged from 60°N, 70°W, to 35°N, 60°W, and the surface consolidated into one large LOW on the 20th. The higher winds were now above 40 kn. The DALAMAN (30°N, 53°W) had 45 kn and 30-ft seas. On the 21st a ship near 29°N, 56°W, had a thunderstorm and 28-ft swell waves. On the 22d a ship west of the center had 45-kn northerly winds, and one east of the center had 60-kn southerly winds. The storm was now traveling east-northeastward with only gale reports. At 1800 on the 24th the AMERICAN ACCORD was west of Lands End near 50°N, 23°W, with 45-kn gales and 28-ft seas. At 0000 on the 25th the storm was 978 mb near Ireland. OWS Romeo had gales with 20-ft seas. The storm slowed as it passed over Scotland. It dissipated on the 27th.

This storm originated over the south-central United States and moved slowly toward the East Coast. Its southerly circulation moved over the Gulf Stream on the 24th. On the back side of the LOW the JOHN G. MUNSON on upper Lake Michigan measured 42-kn northerly winds with an air temperature of -7°C. The storm brought high winds all along the coast. Wallops Island, Va., and Wilmington, N.C., both measured 45 mi/h. Blue Hill Observatory, Mass., measured 44 mi/h and the Mt. Washington Observatory, N.H., measured 119 mi/h. The 993-mb center was over Maine on the 26th. Several ships reported winds over 40 kn in the southerly flow. One near the front had 30-ft seas. The ALEX STEPHENS (36°N, 61°W) logged 65-kn southerly winds with 12-ft seas and 17-ft swells. The DELTA DRECHT had been reporting winds near 40 kn, but they jumped to 78 kn at 1800 near 40°N, 62°W. On the 27th the CG11 near 46°N, 60°W, radioed 60-kn winds. On the 28th the storm crossed into the Labrador Sea and continued up the Greenland coast to oblivion.

Casualties--Melting snow and ice jams flooded many rivers in the Midwest during the month. The Coast Guard cutter SCIOTO sank on the Missouri River near Leavenworth, Kans. The 13,209-ton Greek STAR LIGHT and the USS FRANCIS MARION collided in heavy fog in Chesapeake Bay on the morning of the 4th. Both ships were damaged with two injuries on the Navy ship. The 48,429-ton Liberian tanker MARILLIA ran into ice off eastern Canada and was holed in the forepeak.

The 13,326-ton Panamanian STAR SUPREME reported encountering heavy weather with damage to gantry bulwark and containers washed overboard upon arrival at La Pallice, France, early in the month. The cargo vessel FRANZ XAVER KOGEL alleged heavy-weather damage during a voyage from Italy to Puerto Rico. The motor vessel ARROI arrived Balboa on the 13th with cargo shifted during heavy weather.

The 32,531-ton British tanker KURDISTAN (fig. 56) broke in two in heavy seas and ice in Cabot Strait on

Figure 56.--Stern half of the oil carrier KURDISTAN about 45 mi northeast of Glace Bay is awash. Wide World Photo.

the 16th. Forty crewmembers abandoned ship in rafts and were rescued by the Canadian Coast Guard icebreaker SIR WILLIAM ALEXANDER. One lone crewman that had remained aboard was rescued by helicopter. The bow eventually sank in the Atlantic by gunfire from a Canadian warship. The stern was towed to Saint John, New Brunswick, for drydocking. The 1,593-ton Polish KORONOWO sank 7 mi west of Bornholm on the 17th after the deck cargo shifted in strong gales. The crew was rescued. The Canadian GULF GRENADIER (513 tons) reported ice damage on the 18th.

The 38,529-ton SEA VALIANT sustained a split in one of her holds during a storm 800 mi north of the Azores on the 19th. The Cypriot DONATA SCHULTE reported heavy-weather damage upon arrival at Barbados on the 27th.

The American yacht COMPASS ROSE capsized in a fierce gale in the South Atlantic between the Falklands and Argentina. She was rescued by Polish vessels. The 12,487-ton Greek tanker VICTORY was damaged while berthing at Recife on the 9th. She struck a jetty in high winds and heavy swell.

SMOOTH LOG, APRIL 1979--Many of the storms out of North America curved northward over Canada or into Baffin Bay. One storm made the trek from Cape Hatteras to the Norwegian Sea. Several storms formed over the water and dissipated while headed northward. In general the storm paths were shifted westward from their climatic tracks.

This month's mean sea-level pressure differed significantly from the long-term normal. The normal indicates the Icelandic Low off Kap Farvel at 1008 mb. The Azores High is 1021 mb south of the Azores near 30°N, 32°W. There is high pressure over the Arctic with the main center off the Queen Elizabeth Islands.

This month the mean sea-level pressure had three low-pressure centers: a 1015 mb over the Bay of Fundy; a 1012 mb near 42°N, 45°W; and a 1010 mb over the North Sea. The Azores High at 1024 mb was centered north of the Azores near 42°N, 20°W. A part of the Azores High split off to become the Bermuda High at 1021 mb near 28°N, 60°W. The primary center of the Arctic High was 1030 mb over the northern coast of Greenland.

The anomaly analysis showed a minus 5-mb center near 36°N, 40°W, with a minus 3-mb center off the Netherlands. The positive centers were the largest this month. A large positive area with two 12-mb centers covered the Arctic Ocean off the U.S.S.R. There was another 12-mb center between Greenland and Iceland and a plus 8-mb center along the northern coast of Labrador.

The upper air normal at 700 mb has a LOW over Kane Basin with a trough through the Labrador Sea that parallels longitude 60°W. There is slight ridging along longitude 25°W. This leads to a trough along 20°E. This month the LOW was over Bathurst Island. There were two troughs out of this LOW, one along longitude 100°W and the other along 70°W. There was also an incipient LOW over Newfoundland with a trough stretching to the southeast. The ridge along longitude 25°W was accentuated leading into a LOW near the Faeroe Islands with that trough stretching southeastward.

The major anomaly centers were positive over Kap Farvel and negative near 35°N, 42°W, and over central Europe.

Extratropical Cyclones--This storm formed on a front associated with a LOW traveling toward Kap Farvel on the 3d. There already was weak cyclonic circulation in the area from another weak LOW close by that was moving eastward. On the 4th the LOW was 996 mb at 36°N, 40°W. It was alined with an upper air cutoff LOW. The KRPAN was near 30°N, 50°W, with 20-ft waves. The BERGLJOT (39°N, 47°W) measured 44-kn winds and 20-ft seas, and at 1200 the EL PASO ARZEW (34°N, 45°W) measured 55-kn northwesterlies with 10-ft seas and 26-ft swells. There were a few isolated gale reports on the 5th and 6th by such ships as the SEA-LAND ECONOMY and the USNS COLUMBIA.

The storm system was drifting slowly eastward. The SAXONIA was sailing northeastward and sending 6-hr reports. On the 7th she had 40- to 50-kn winds and waves as high as 33 ft. On the 8th the storm was 998 mb centered over the Azores. On the 9th the OLKUSZ and S. FRANCOIS were both near 39°N, 10°W, with 52- and 50-kn wind reports. The latter reported 20-ft swell waves. A ship northwest of the center radioed swell waves of about 26 ft. On the 10th OWS Romeo measured 20-ft swell waves. The winds were generally 20 to 30 kn, but a ship near 40°N, 20°W, reported 40 kn. On the 11th the LOW was maintaining

its central pressure, but losing its circulation as it traveled northward to completely dissipate on the 13th.

Monster of the Month--This story begins on the 4th. High pressure was moving across the Great Lakes. A small LOW was near the juncture of the Ohio and Mississippi Rivers. Another was over northern Hudson Bay and yet another near Lake Winnipeg. On the 5th the LOWs from the Ohio River Valley and Lake Winnipeg were moving northeastward and developing in the usual manner. On the 0000 chart of the 6th both of these LOWs had disappeared, and a new, more intense one was found over Sault Ste. Marie at 994 mb. This storm intensified and moved across the top of the Great Lakes Basin.

The night of the 5th Meigs airport in Chicago, Ill., had gusts to 60 kn. The Coast Guard station recorded 70 kn. In Cook County and Chicago a church steeple toppled, power cables snapped, windows were smashed, and chunks of marble fell from high downtown buildings. In northern Illinois one man was killed, and 37 people were injured. Winds up to 50 kn were blowing from Michigan to New York on the 6th, and there was snow of as much as 1 in per hr in some places. Pellston, Mich., had a gust to 82 mi/h. The Mackinaw Bridge was closed. A seiche was set up on Lake Erie, and ice packs were blown ashore crashing into lakefront homes. Buffalo, N. Y., had gusts to 40 kn on the 5th and 43 kn on the 6th. Detroit had 49-kn gusts on the 5th, and Sault Ste. Marie had 41-kn gusts on the 6th. In Michigan hundreds of buildings were partially unroofed. Power outages affected 225,000 customers. Peak gusts averaged 65 mi/h inland and about 80 mi/h along the eastern shore of Lake Michigan. The winds gusted as high as 90 mi/h near Lake Ontario, where

Figure 57.--The Canadian freighter LABRADOC is awash as she founders in Lake Erie. Wide World Photo.

high waves and ice damaged the shore and homes and businesses along the shore. The J.A.W. IGLEHART was on central Lake Michigan with measured 55-kn winds out of the northwest and 7-ft seas. The 325-ft Canadian ore carrier LABRADOC was lashed by 50-kn winds and 15-ft waves and began taking on water on Lake Erie about 18 mi northwest of Ashtabula, Ohio. The cargo of corn shifted, and the ship listed heavily to port. Fifteen crewmembers were initially rescued by helicopter; 4 hr later the Captain and three others left the ship as it started breaking up (fig. 57). The ship was taken in tow on the 7th and grounded on Pelee Island on the 8th.

At 1200 on the 6th the 985-mb storm was due north of Buffalo, N.Y., and it was bringing strong winds to the East Coast. Wallops Island, Va., measured 40-kn gusts and Blue Hill Observatory in Maine had 41 kn. On the 7th Newark Bay was closed to large ships. The replica of the 19th century schooner PRIDE OF BALTIMORE (fig. 58) was blown 200 mi off course to Delaware Bay from its intended destination of Norfolk. Ships off the coast were reporting 40-kn gales. By the 9th the LOW was north of the Gulf of St. Lawrence and of no consequence. It turned northwestward and ended over Hudson Bay.

This storm came off the eastern slopes of the Canadian Rocky Mountains. On the 9th the LOW was still west of the Appalachian Mountains, but late in the day shipping off the East Coast was feeling its influence. At 1800 the GREEN HARBOR was west of the front with 70-kn northwesterly winds, while the DELAWARE SUN was east of the front with 50-kn southwesterly winds and 23-ft waves.

On the 10th the OPALIA (34°N, 75°W) reported 61-kn westerly winds with 23-ft waves. The storm was moving eastward south of Long Island but immediately turned northeastward to parallel the coast. This was in response to a high-pressure ridge that extended southward from a 1050-mb center over Greenland. On the 11th the tighter gradient was between the front and the ridge. Three ships reported winds over 40 kn in the vicinity of 45°N, 60°W. The GUAYAMA radioed a report of 40-kn winds, 28-ft seas, and 33-ft swells at 2300 on the 10th from 38°N, 63°W. At 0600 on the 11th the winds and waves were still the same force. Later in the day the center magically vanished as another center developed to the south.

This LOW formed in a trough southwest of another LOW that was moving northeastward. At 0000 on the 14th this storm was near 38°N, 49°W. The other LOW had moved to 46°N, 38°W. The primary circulation surrounded both centers. Ships in the northeasterly flow reported 20- to 30-ft swells. The WILD GREBE (43°N, 51°W) had only northerly 40-kn winds, but her swell waves were northeasterly at 36 ft. The KOSMONAUT GAGARIN had northwesterly 58-kn winds and 21-ft seas.

By 0000 on the 15th the LOW was 968 mb near 50°N, 36°W. OWS Charlie had 47-kn winds at 1200. By 0000 on the 16th the northeasterly LOW, which had turned to the north-northwest, became the storm center at 968 mb. The ship UNLM was near the center with 971-

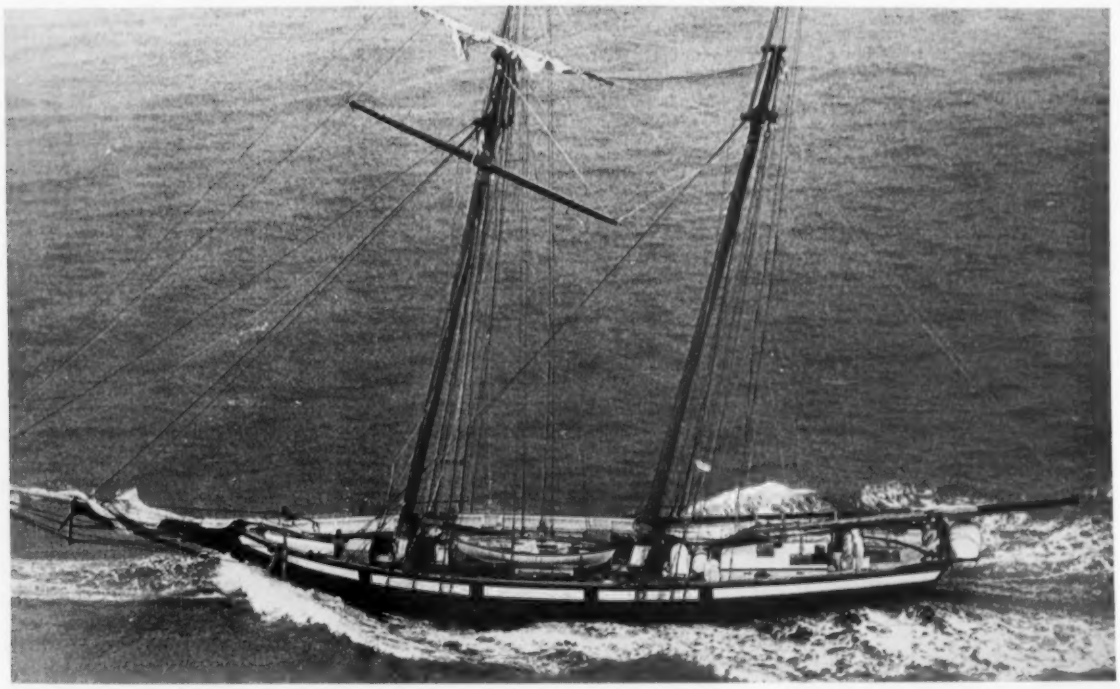


Figure 58.--The two-masted schooner PRIDE OF BALTIMORE plows through Delaware Bay under tow by the Coast Guard cutter POINT FRANKLIN. Wide World Photo.

mb pressure, 50-kn winds, and 23-ft seas. The LOW drifted northwestward into the Labrador Sea and weakened rapidly as the next storm moved into the area on the 17th.

A complicated frontal system was approaching the Appalachian Mountains on the 14th with the warm front hanging to the south and turning sharply eastward over North Carolina. The warm front lay over Cape Hatteras with a squall line extending into northern Florida. By 1200 a frontal wave had formed off Hatteras. By 0000 on the 16th the storm was 980 mb near 40°N, 59°W. The EASTERN NEPTUNE (39°N, 60°W) measured 983 mb with 60-kn southwesterly winds. Six hours later the ARCTIC TROLL was near the same location (39°N, 59°W) also with 60-kn winds and 33-ft swell waves. Her pressure was 990 mb. The CAR - CHESTER was following the storm with 25-ft waves. On the 17th the RUDBY had 55-kn winds and 41-ft swell waves south of the center.

The storm was tracking toward the northeast and weakening on the 18th. It moved over Iceland on the 19th with 16-ft waves for OWS Lima. It continued into the Barents Sea on the 22d.

This LOW formed in the wake of the last storm south of Newfoundland on the 17th. At 1200 on the 18th, the LOW was 1000 mb near 40°N, 57°W. The AMERICAN ARCHER was about 90 mi away with 20-ft swells. Six hours later the SLEIDRECHT was near the center with 60-kn southwesterly winds and 26-ft waves. At 0000 on the 19th the storm was 980 mb but less than 600 mi in diameter. A ship close to the center had 45-kn winds. This storm resembled a tropical cyclone in its size and strong winds near the center. After passing over Cape Race it rapidly dissipated on the 20th.

The last third of the month was relatively quiet. There were several LOWs that traversed the shipping lanes from off the east coast of the United States to near Iceland. A large HIGH in the 1030-mb plus range off of France blocked eastward passage of these LOWs.

One last storm of the month beat the blocking High by forming over Denmark Strait and moving across the top. On the 28th the LOW was making a counterclockwise loop over the Norwegian Sea. An English ship, the GTOT was south of the Faeroe Islands with 44-kn winds. On the 29th the same ship still had the strong gales and now reported 20-ft waves. On Jan Mayen Islands winds were measuring 40 kn.

At 1200 on the 29th the 976-mb storm was near 68°N, 10°E, and moving southward. At 1800 vessels over the northern North Sea were reporting winds in the upper 40-kn range. The RIGG reported 52-kn winds and 20-ft seas. At 0000 on the 30th the Faeroe Islands measured 50 kn. As the LOW moved southward over Scandinavia, it brought waves up to 20 ft off the coast.

On the 30th there was a raft of reports over 40 kn as if ships were rushing to meet their monthly quota. In general wind reports were consistently between 40 and 50 kn over the North Sea. There were several reports of 33-ft waves over the northern part. At 0300 a report from the PLAT indicated 60-kn northwesterly winds and 26-ft seas.

Late on the 30th the storm turned northward again and stalled near 69°N, 05°E, on May 2. On the 1st the DRUPA had only 38-kn winds near 61°N, 01°W, but had 33-ft swells. The SERENIA nearby at 61°N, 02°E, had 46-kn winds and 30-ft waves. As the storm stalled, it gradually lost its power; and the gale-force winds crept northward until they were no longer supported. The storm stayed in nearly the same position until the 9th.

Some weather highlights for April around the United States. Record flooding and rain hit Mississippi and North Dakota. Ten to twenty inches fell on the upper Pearl River basin. The Pearl River rose to 43.3 ft on the 17th producing the worst floods ever. During the last week of April, heavy rains and thawing produced the highest water levels recorded this century on the Red River in North Dakota and Minnesota. In the second week of the month heavy rains flooded the streets in Houston and Beaumont, Tex. The last week heavy rains hit southern Florida.

Casualties--The Greek vessel SAPHO (17,867 tons) arrived Honolulu April 1 after heavy weather aggravated former frame damage. The 1,236-ton Venezuelan KATYA sank in rough seas 80 mi from Aruba on the 6th. All were rescued. The 3,672-ton Panamanian IMPALA arrived Bilbao on the 12th with position lights broken by heavy weather. The 855-ton dredger sank in heavy weather near 58°N, 08°E, on the 3d. The 1,599-ton Panamanian ELLI sprang a leak and sank in heavy seas on the 12th near 44°N, 09°W.

The British bulkcarrier RAVENSWOOD contacted heavy ice on the 13th 45 mi west of Port aux Basques with slight damage. The British JACK WHARTON (1,597 tons) arrived England on the 17th with apparent heavy-weather damage to cargo. The 9,043-ton Greek STROFADES was icebound at Sault Ste. Marie anchorage on the 11th and had ice damage on voyage into the Lakes.

Helicopters and fishing boats rescued 44 persons from the burning 6,000-ton Polish freighter REIMUND off Bornholm Island on the 16th. Strong winds and heavy seas were occurring at the time. The 60,789-ton Liberian tanker SEATIGER (fig. 59) was struck by lightning in Port Arthur, Tex., after unloading 230,000 barrels of oil on the 19th. Three people were killed and 30 injured. The vessel exploded and burned.

Figure 59.--The side of the SEATIGER was blown open by the explosion after she was struck by lightning. U.S. Coast Guard Photo.

Figure 60.--This French photograph of the GINO shows her with a heavy list prior to sinking after colliding with the TEAM CASTOR. Wide World Photo.

The 14,622-ton Greek MARIVERDA had heavy-weather damage on the 19th and 20th on a voyage from Jeddah to Bordeaux.

The 6,366-ton Liberian MOUNT DIRFYS arrived in Norfolk on the 21st with a cargo of combat tanks that were damaged when the tanks shifted in heavy weather.

The 30,560-ton JAGUAR struck a small iceberg in Belle Isle Strait on the 26th. The 28,695-ton Liberian tanker GINO (fig. 60) and the 18,673-ton Norwegian TEAM CASTOR collided in fog off the Brittany coast on the 28th. The GINO sank but the TEAM CASTOR made port. All crewmen on the GINO were rescued by the Soviet ship VELIKY OKTIABR. The 23,207-ton Canadian IRVING ARCTIC encountered ice off Newfoundland.

Smooth Log, North Pacific Weather

March and April 1979

SMOOTH LOG, MARCH 1979--Sometimes it's surprising how close the average monthly storm paths match the climatological paths. The majority of the low-pressure centers this month were weak and diffuse with short lives. Many dissipated rapidly with a new one forming to take its place. This is what the climatological tracks indicate. This month the primary area of cyclogenesis was near Japan. The storms took two primary paths, one along the Kurile Islands and the western Bering Sea, and the other more eastward to midocean where high pressure off the U.S. West Coast deflected them northward into the eastern Bering Sea. A significant number of LOWs entered the Gulf of Alaska, but they were generally secondary LOWs that formed or broke away from the primary storms. A few storms sneaked south of the high pressure to the California coast.

The Aleutian Low was located near its normal sea-level climatic position at 50°N, 170°E. Its pressure was 996 mb versus the climatic 1005 mb. A climatic 1007-mb Low over the Gulf of Alaska was represented by a trough. The Pacific High was within 1 mb and a few miles of its climatic counterpart. The Arctic High over the Arctic Ocean was 1041 mb, 18 mb higher than climatology. The 45-mb pressure difference between the Aleutian Low and the Arctic High produced

a gradient more than twice its normal strength of 18 mb.

The primary anomaly center that affected the marine weather encountered by ships was minus 11 mb near 47°N, 175°E. The other significant anomaly was plus 21 mb with the Arctic High centered near 80°N, 130°E.

The mean 700-mb height pattern differed radically only over the Arctic Ocean where a closed High replaced only climatic ridging. The Aleutian Low was 38 m deeper and shifted east of the Kamchatka peninsula, rather than west as shown by climatic charts. Even with the closed High over the Arctic, the usual ridging over the North American west coast was near normal. As at the surface the two primary anomaly centers were near their pressure centers. Different from sea level and probably significant was a plus 48-m anomaly centered over Dixon Entrance.

Extratropical Cyclones--This LOW developed in an inverted trough south of Kobe on the 3d. On the 4th the LING YUNG was north of the storm with heavy rain and 26-ft swell waves. By 0000 on the 5th the 980-mb storm was near 33°N, 150°E. Three ships reported winds of 60 kn or more north, west, and south of the center. The ASIA MARU had 65 kn with 33-ft waves on the 982 isobar. The LING YUNG was still north of the storm with only 48-kn northeasterly winds, but she was calling the seas 49 ft and the swells 66 ft. The FEDERAL SUMIDA (28°N,148°E) reported 46-ft swell waves. On the 6th the LOW was racing eastward along 35°N. The MAYA PIONEER felt the sting of 65-kn winds 300 mi south of the center and nearby the STREAM HAWSER had 30-ft waves crashing on her bow. On the 7th the storm had raced past the PRESIDENT TAFT and another ship treating them to 55-kn winds and waves of 25 ft. A ship in the southeast quadrant had 33-ft waves. At 1200 the occlusion passed the CGC SEDGE, which was sailing southward into 55-kn winds and 17-ft seas.

The storm was traveling northward on the 8th at 960 mb near 49°N, 159°W. The higher winds and waves were 40 to 50 kn and 25 to 30 ft. The storm was weakening as it neared the Alaska Peninsula and disappeared over the Bering Sea on the 11th.

A sharp trough moved across Japan on the 5th and 6th. A LOW had formed off Hokkaido on the first chart of the 7th. By 1200 winds over 40 kn were blowing in the southwest quadrant. The LING YUNG was now caught in this storm and had 26-ft seas and 33-ft swells on the 8th. The JUJO MARU No. 2 (44°N, 170°E) had 57-kn winds and 30-ft waves. The high waves continued for the next 30 hr. At 1200 on the 8th the LOW was 972 mb near 48°N, 170°E. On the 9th the PACIFIC ARROW at 38°N, 179°E, measured only 35-kn winds, but the seas were 26 ft and the swells 33 ft. The JELA TOPIC was west of the center with 50-kn winds and 23-ft seas. On the 10th the PACIFIC ARROW reported 20-ft seas and 33-ft swells. The storm started weakening rapidly late in the day and quickly dissipated.

This LOW crossed the Sea of Japan on the 10th. Immediately after the center crossed Hokkaido the storm intensified. Japanese and Soviet ships near the Kurile Islands registered 40- to 50-kn winds. One, the GVARDEISK south of Ostrov Iturup reported 60-kn northerly winds and 20-ft seas. Three ships mailed in reports of winds of 60 kn or greater. The GLADIOLUS had the highest--a measured 65 kn--with 21-ft waves. The PRESIDENT TAYLOR supplied the highest seas of 30 ft. By 1200 on the 12th, the storm was 960 mb near 50°N, 158°E. The weather station on Ostrov Urup measured chilling 55-kn winds at -9°C. At 0000 on the 12th there were 35 ship reports of winds of 40 kn or greater in the vicinity of the storm. The SANKOSTAR and WAKASUGISAN MARU both reported 33-ft waves. The VANGUARD (43°N, 151°E) reported 60-kn winds and 36-ft waves. At 0600 the PRESIDENT TAYLOR near 41°N, 148°E, was hammered by 60-kn westerly winds and 49-ft seas and swells.

The storm must have chased many of the fishing vessels into port as the number of reports dropped on the 13th and 14th. The VAN ENTERPRISE (42°N, 156°E) had 68-kn winds at 0600 on the 13th. These dropped to 40 to 50 kn on the 14th. The storm was moving up the Kurile Islands and no longer existed on the 16th.

As the storm above moved up the Kurile Islands a frontal wave formed near the Bonin Islands on the 12th. The upper air LOW was associated with the older surface LOW, and this wave was under the influence of zonal flow aloft and traveling eastward parallel to latitude 30°N. On the 13th the PRESIDENT ROOSEVELT was north of the incipient storm with 30-ft northerly swell waves from the older storm. By 1200 on the 14th the storm was 984 mb near 34°N, 169°E. A ship west of the center had 50-kn winds from the north with 20-ft seas and 23-ft swells. The SANKOSTAR was caught by this storm on the 15th near 40°N, 179°W, within 6 mb of its center with only 40-kn winds but the seas were 26 ft and the swells 39 ft from the south. The storm on a northerly track crossed the eastward course of the PRESIDENT ROOSEVELT and left behind 50-kn winds and waves of 41 ft.

At 0000 on the 16th the storm was 960 mb near 49°N, 178°W. The JGPE was 300 mi to the south with 60-kn winds. No one ventured out to estimate the waves. The PRESIDENT ROOSEVELT hung in there with 48-kn winds and 36-ft seas. Early on the 17th the HONSHU GLORIA (51°N, 163°W) measured 42-kn winds, 25-ft seas, and 30-ft swells. This LOW dissipated near the Shumagin Islands on the 17th as a short-lived LOW moved into the eastern Gulf of Alaska. The NEWARK at 55°N, 139°W, found 20-ft seas and 33-ft swells.

This storm was born over the East China Sea about 36 hr after the previous one. It followed a more east-northeasterly track. On the 16th there were a few 40-kn wind reports with 15- to 20-ft waves. By the 17th the LOW was 954 mb near 44°N, 172°E. The PAPYRUS MARU (46°N, 169°E) about 120 mi northwest of the center had heavy snow, 45-kn winds, 26-ft seas, and 33-ft swells. The ASIA ZEBRA was near the point of occlusion with 26-ft waves. The DAIRIN MARU was sailing eastward as the storm traveled northeastward and had winds of 60 kn or more for over 24 hr. Her waves were running about 25 ft and the highest wind was 70 kn near 42°N, 172°E. The WESTOCEAN found 38-ft waves. This storm was absorbed by an approaching storm on the 19th.

This storm came out of Manchuria and was over the Sea of Japan on the 16th and 17th. Late on the 17th found the CRESSIDA with 44-kn measured winds, 26-ft seas, and 30-ft swells near 32°N, 145°E. The BISCAY MARU (35°N,152°E) had 50-kn winds on the 18th. The MAERSK

CADET was nearby (35°N,150°E) with 50-kn winds and 33-ft seas and swells. At 1200 the SHINZUI MARU (44°N, 154°E) was about 150 mi south of the 976-mb storm with 60-kn winds. There were three ships in the vicinity of 42°N, 151°E, measuring winds from 48 to 56 kn with only the EASTERN VENTURE reporting waves; they were 23 ft. On the 19th several other ships had winds near 60 kn with waves up to 25 ft. By the 1200 chart this storm had absorbed the previously described storm. The GARDENIA was on the southwest edge of the circulation traveling with the storm. For 24 hr, 0600 on the 19th to 0600 on the 20th, along latitude 35°N from 156°E to 162°E she had three observations with waves over 50 ft. All portions of the observations appeared good and fit the analysis. Although some distance away (42°N, 152°E) the GOLDENROD verified that very high waves existed over a large area with 44-ft seas and 49-ft swells, with measured 55-kn winds. At 0000 on the 20th the WORLD FINANCE (40°N, 170°E) also verified with 41-ft waves. The storm was now 968 mb near 50°N, 180°, and moving northward into the Bering Sea. It filled rapidly.

This storm crossed Japan on the 24th as tropical storm Bess moved northeastward out of the Tropics. Ships east of Japan were caught by 40- to 45-kn winds. Bess fed warm moist air northward east of the front bringing heavy rain. At 1200 on the 25th, Bess was rated a tropical storm near 26°N, 148°E. By 0000 on the 26th there was no indication on the analysis she existed, but she had fed vast amounts of energy into this extratropical storm. At this time it was 970 mb near 46°N,154°E. The HARFLEET (41°N, 149°E) and the RYOKO MARU (42°N,154°E) both had winds over 50 kn and swell waves of 39 ft. Others were generally reporting 20 ft.

On the 27th the LOW was 978 mb near 49°N,165°E. A Korean ship near 43°N, 160°E, reported 39-ft waves. A ship in the same relative position to the center had 33-ft swells on the 29th. The storm was curving westward, then southwestward, and disappeared on the 30th.

This LOW came across the Yellow Sea and was already a 978-mb storm as it moved through the Tsugari Strait on the 30th. By the 31st the area bounded by 30° and 40°N and 140° and 155°E was loaded with strong gale-wind reports. Winds of 116 kn were reported in the mountains west of Tokyo. In other areas of Kyushu and Shikoku the winds blew up to 55 to 75 kn. Railway and aircraft traffic was stalled in many areas. A 400-yr-old cedar tree at a shrine was toppled and eight 350-yr-old cedar trees lining an avenue in Kikko in the mountains north of Tokyo were blown over. A ship with the call letters D5NL reported 25-ft seas. The PRESIDENT KENNEDY (44°N, 154°E) northeast of the 966-mb storm had 45-kn winds and 26-ft seas. The AMERICAN LEGION (37°N, 147°E) encountered 60-kn southwesterly winds driving 30-ft seas. The MOSEL EXPRESS found 33-ft swells. It appears that the SEA-LAND EXCHANGE sailed almost directly through the storm's center at 1100 on the 31st with a pressure of 958 mb. The winds switched from east to north to west over a 4-hr period with the highest speed 50 kn and waves 20 ft. The hourly winds and pressures were recorded on the back of the barogram from 2200 3/30 to 0700 4/01. They were strongest in the southwest quadrant from 2100 3/31 to 0500 4/01.

On April Fools Day the WELSH CITY (35°N, 152°E) was finding 55-kn winds and 36-ft waves. The MIDAS RHEIN sailing south of the center and toward it had 64-kn winds. Waves reports over 25 ft extended from 145° to 175°E south of the center. She continued to have 60-kn winds and 25-ft seas into the 2d.

As the storm moved into the central ocean, its influence stretched from 30° to 65°N and 145°E to 150°W. The higher winds were about 45 kn and the waves 30 ft between latitudes 35°N and 40°N. On the 3d the storm was over the cold Bering Sea and retreating. The gradient had relaxed and it was no longer significant to large ships.

Tropical Cyclones--Typhoon Bess came to life on the 20th about midway between Yap and Guam. Beginning as a depression, she reached tropical-storm strength the following day. Bess was heading toward the northwest. By the 22d she was at typhoon strength. Peak winds climbed to 80 kn on the 23d as the typhoon continued to recurve and headed northeastward. By the 25th Bess was a tropical storm chugging south of Iwo Jima as she finished her tour of famous World War II islands.

Casualties--This was a bad month for Greek vessels on the North Pacific. The 14,202-ton Greek bulkcarrier MAIROULA reported Taiwan on the 8th with heavy-weather damage. The 12,498-ton AEGIS MAJESTIC sustained heavy-weather damage to deck pontoons. The 13,313-ton Greek bulkcarrier SEMI requested survey for heavy-weather damage on arrival at Innoshima on the 17th. The Greek bulkcarrier SAPHO (17,876 tons) sustained heavy-weather damage on the 29th while 300 mi north of Honolulu. Vessel diverted to Honolulu for repairs. The 3,107-ton Taiwanese TA LAI ran aground near 35°N, 126°E, on the 30th attempting to take shelter from heavy weather.

In the southern ocean the 3,179-ton Nauruan-registered CENPAC ROUNDER ran aground during cyclone Meli near 18.5°S, 177.7°E, on the 27th.

SMOOTH LOG, APRIL 1979--The majority of this month's storms traveled over the western part of the ocean into the Bering Sea. Two storms during the second week of the month made it from the western ocean into the Gulf of Alaska. A group of storms wandered over the ocean north of Hawaii. Several storms developed on the east and northeast side of the Pacific High and affected the North American coast.

The major differences from climatology were that the storm tracks were shifted westward and a primary track from south of Fox Islands in the Aleutians into the Gulf of Alaska was missing.

There were major differences between this month's mean sea-level pressures and pattern and the climatological normals. Climatology indicates four low centers of 1009 and 1010 mb from the Kenai Peninsula to north Sakhalin Island. The Pacific High at 1023 mb is elongated along latitude 33°N. High pressure over the Polar region is 1021 mb maximum.

This month the mean showed one 1000-mb LOW at 55°N, 175°E. The Pacific High was elongated as usual with a central pressure of 1025 mb near 40°N, 153°W. The maximum pressure over the Polar region was 1030 mb.

These differences resulted in significant anomalies.

Two had the most affect on ships. One was a minus 10 mb with the Aleutian Low near 55°N, 175°W. This negative area covered the corner of the North Pacific west of Alaska's west coast and north of latitude 40°N. The other was a plus 9-mb center over the Gulf of Alaska near 57°N, 147°W. There was a plus 12-mb center over the Polar region. There is no doubt that this affected the global weather, but not over the North Pacific directly.

The upper air circulation at 700 mb was also significantly different. There was a closed LOW over the Bering Sea instead of the normal trough. The normal ridging over the North American coast was sharper and west of the coast. This produced anomalies corresponding to those at the surface.

Typhoon Cecil occurred this month.

Extratropical Cyclones--This is a transition month from the large, deep winter storms to generally weaker summer storms. The majority of the deeper storm systems tracked into the Bering Sea as indicated by the mean pressure pattern. In general, the Pacific High was well established and farther north than usual blocking the entrance of storms into the Gulf of Alaska.

The first significant storm of the month moved over the East China Sea on the 1st. It tracked east-northeastward south of Japan. On the 4th the MIDAS RHEIN at 38°N, 151°E, measured 49-kn winds and 15-ft seas. The storm was 994 mb near 45°N, 178°E, by 0000 of the 5th. It was generating only minimal gales. At this time it turned sharply northeastward, and at 0600 the CRESSIDA found 60-kn westerly winds as the storm started deepening. The seas were 26 ft. At 0000 on the 6th the storm was over the Aleutians at 960 mb. The SHIN SHIEN (47°N, 168°W) had 58-kn winds, but only reported 13-ft seas. A Japanese ship was north of Dutch Harbor with 78-kn winds. The JAPAN VENTURE south of the center by 350 mi reported 53 kn.

The storm was tracking up the island chain. On the 7th a SHIP near 43°N, 141°W, had 60-kn winds on her starboard beam slightly east of the warm front. Other ships including the PRESIDENT MADISON were reporting 40-kn winds with waves as high as 20 ft. The PACIFIC VENTURE (53°N, 171°W) fought 25-ft seas. At latitude 55°N the storm turned eastward while weakening and disappeared from the analysis by the 10th.

This storm was a frontal wave that extended from the previous LOW on the 6th. By 1200 on the 7th this was a small tightly wound storm at 984 mb near 39°N, 172°E. Several ships reported 50-kn winds, including the MUREX with 23-ft waves. The ALVA MAERSK near 36°N, 166°E, had giant 41-ft seas. A ship with the call letters JKMG was traveling with the storm with 45- to 50-kn winds and waves of about 20 ft. On the 9th the storm was moving northeastward. The HOHB was near 44°N, 169°W, with 47-kn winds, 36-ft seas, and 26-ft swells. As the storm moved south of the Alaska Peninsula and over the top of the 1034-mb Pacific High, it dissipated rapidly.

This LOW formed on the occlusion associated with a cyclone over the Sea of Okhotsk on the 10th. By 0000 on the 11th it was 986 mb near 54°N, 166°E. At 2300 on the 10th the HARNGJIN near 50°N, 168°E, measured 38-kn winds with 15-ft seas and 33-ft swells. At 1100 on the 11th she reported 40-kn winds driving 17-ft seas and 39-ft swells near 49°N, 165°E. The NEPTUNE DIAMOND was nearby with 40-kn winds, but did not report waves. On the 12th the storm was filling, and it was no longer on the analysis by 1200 on the 13th.

This was an example of a case of explosive development which often catches forecasters flat-footed, especially in data-sparse areas. The 1200 chart of the 11th showed the 1030-mb Pacific High at 35°N, 137°W. There was a 1039-mb HIGH centered over the north coast of Alaska. A weak front wrapped around the top of the Pacific High with a col area off the Alaska Panhandle. The upper air chart had a weak LOW over Vancouver Island associated with a weak surface LOW over the state of Washington. A small surface LOW was indicated on the 1800 chart of the 11th.

By 1200 on the 12th the LOW was 984 mb off Vancouver Island. The upper air LOW had suddenly deepened. At 1800 ships along the Washington-Oregon coast were finding 40- to 50-kn winds. The ALASKA STANDARD (52°N, 130°W) had 50-kn winds. The ARCO JUNEAU measured 44-kn winds and 33-ft seas near 46°N, 130°W. At 0000 on the 13th the buoy 46005 measured 45-kn winds and 26-ft waves. The OVERSEAS JUNEAU (48°N, 130°W) had 60-kn winds with 23-ft waves and the EXXON BATON ROUGE (46°N, 129°W) measured 55-kn westerly winds with 49-ft swell waves. The ARCO JUNEAU was now reporting 41-ft swells still near 46°N, 130°W. She had moved only about 6 mi in 6 hr. At 0600 buoy 46005 and buoy 46002 measured 21-ft waves. By 1200 on the 13th the LOW had moved inland, and a few hours later it was no longer significant.

A LOW was over the Sea of Japan on the 16th. As it crossed Japan, double centers developed and the second center persisted. At 0000 on the 17th the FRIENDSHIP was east of the second center with 45-kn southeasterly winds at the warm front. The VAN ENTERPRISE was between the two centers near 40°N, 147°E, with 58-kn westerly winds. Neither reported waves. By 0000 of the 18th the LOW had consolidated into a 974-mb center near 46°N, 156°E. The PAPYRUS MARU was about 180 mi south of the center at 0600 with 50-kn winds and 26-ft swells. At 2100 the YAMASHIN MARU was about 600 mi southwest of the storm's center with 58-kn northwesterly winds and 28-ft waves.

The storm moved northward on the 19th and 20th. On the 20th the GARDENIA had 40-kn winds, 36-ft seas, and 20-ft swells as she sailed westward through the front near 52°N, 170°W. At 1200 Ostrov Beringa measured 45-kn winds. On the 21st the LOW moved over eastern Siberia.

A LOW from the East China Sea moved eastward south of Japan on the 19th and 20th. Late on the 20th this LOW developed at the occlusion east of the other LOW and within 12 hr was the only center. At 1200 on the 21st the TOYOTA MARU No. 1 had 40-kn gales on her stern. On the 22d the ADRIAN MAERSK, about 100 mi south of the 979-mb center, had 45-kn winds and 20-ft swells. The GARDENIA was caught by this storm near 51°N, 167°E, at 1800. She measured 42-kn winds, but the seas were 29 ft and the swells 31 ft. The LOW was 967 mb near 52°N, 175°E, at 0000 on the 23d. The

FREISENSTEIN was near the center with 971 mb and 23-ft swell waves. The PRESIDENT WILSON and PACBARON had 55-kn winds and waves to 23 ft near 54°N, 170°W. In the southwest quadrant the JUNEAU MARU (48°N, 169°E) had 44-kn winds from 290° driving 13-ft seas mixed with 33-ft swells from 360°. At 1200 observations were sparse, but St. Paul and Unimak Islands measured 35-kn winds. Also the NORTH STAR III measured 55-kn winds south of Umnak Island. The Coast Guard cutter STORIS was north of St. Paul Island on the 24th with 40-kn winds and 20-ft seas. The storm moved through the Bering Strait later in the day.

Another storm of Chinese origin. It passed over Hokkaido bringing heavy rain to the islands. It caused little disturbance as it traveled northeastward into the Bering Sea. At 0000 on the 26th the 990-mb storm was near 51°N, 175°E. The GLADIOLUS was northeast of the center near 55°N, 171°W, with 58-kn southerly winds. At 0600 the HOHB had 25-ft waves south of the Fox Islands. St. Paul Island had gusts to 40 kn, and at Cold Bay they exceeded 40 kn.

On the 27th the Coast Guard cutter JARVIS south of Saint George Island had 50-kn winds from the south. The PRESIDENT JEFFERSON was north of Umnak Island with 45-kn southwesterly winds and 30-ft seas. The storm was now 968 mb, but it rapidly eroded as it traveled over ice and through the Bering Strait.

More rain for Japan as this storm passed south of the Islands on the 26th. The storm was east of Tokyo on the 27th when two ships north of the warm front had winds over 40 kn and seas to 20 ft. On the 28th a ship with 991-mb pressure had 50-kn winds and 23-ft waves near the center of the 990-mb storm. The LONDON VISCOUNT was traveling with the storm and faithfully radioing weather observations. At 0600 on the 28th she had 50-kn winds about 210 mi south of the center. Waves of 20 to 25 ft were being reported in the southwest quadrant. The LING YUNG was near the warm front (42°N, 176°W) with 45-kn winds from the southeast and 33-ft swells.

It appeared that this storm was going to make it across the Gulf of Alaska, but it was weakening; and this center disappeared on May 2 as another formed.

Tropical Cyclones--Cecil was spotted on the 11th east of Palau Island and west of Woleai. He began a trek toward the west-northwest. On the 13th as a tropical storm, Cecil moved across Palau, a former major Japanese naval base. He became the first male typhoon the following day. Maximum winds climbed to 80 kn near Cecil's center before he rammed ashore over Leyte on the 15th. On the 16th Cecil blanketed the Visayas group with strong winds and heavy rains. Cecil was responsible for 29 deaths with at least 100 people missing. Crop damage was estimated at almost $3.6 million. Cecil weakened and recurved for the next few days. By the 20th he was heading northeastward as a weakening tropical storm, crossing the 130th meridian near 21°N.

Casualties--The 7,809-ton Singapore-registered NEPTUNE SAPPHIRE bound for Kobe reported heavy-weather damage on the 3d. The 108-ton fishing vessel CITY OF SEATTLE sank 90 mi off Yakutat on the 7th. The crew was saved by the Coast Guard. The weather at the time was 12-ft swells and 40-kn winds. The Liberian cargo vessel AL REDHA reported damage by a lighter in bad weather at Chittagong Roads on the 11th. The 13,193-ton Liberian YULSAN POSEIDON and the 15,533-ton Korean TRIDENT were blown aground by strong winds in Busan harbor on the 24th.

On the 25th there were four collisions involving eight ships in fog. The 999-ton SHINCHO MARU and the 499-ton KAISEI MARU collided near Tokyo Bay. Twelve crewmen were missing. On the Inland Sea the 11,463-ton ferry SUNFLOWER with 984 passengers and 44 crewmen collided with the 1,133-ton containership MEIKO MARU with a crew of 13. All persons were safe. The ferry towed the containership to shallow waters as it was leaking. The 13,267-ton Liberian freighter VALERIA and the 619-ton LPG carrier No. 5 SHOGI MARU brushed each other, and the 10,381-ton Greek cargo ship FRATERNITY and the 682-ton LPG carrier KAIHO MARU scraped each other.

The 261-ton tug ESSAR towing two barges encountered heavy weather south of Hawaii, and the towline broke.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

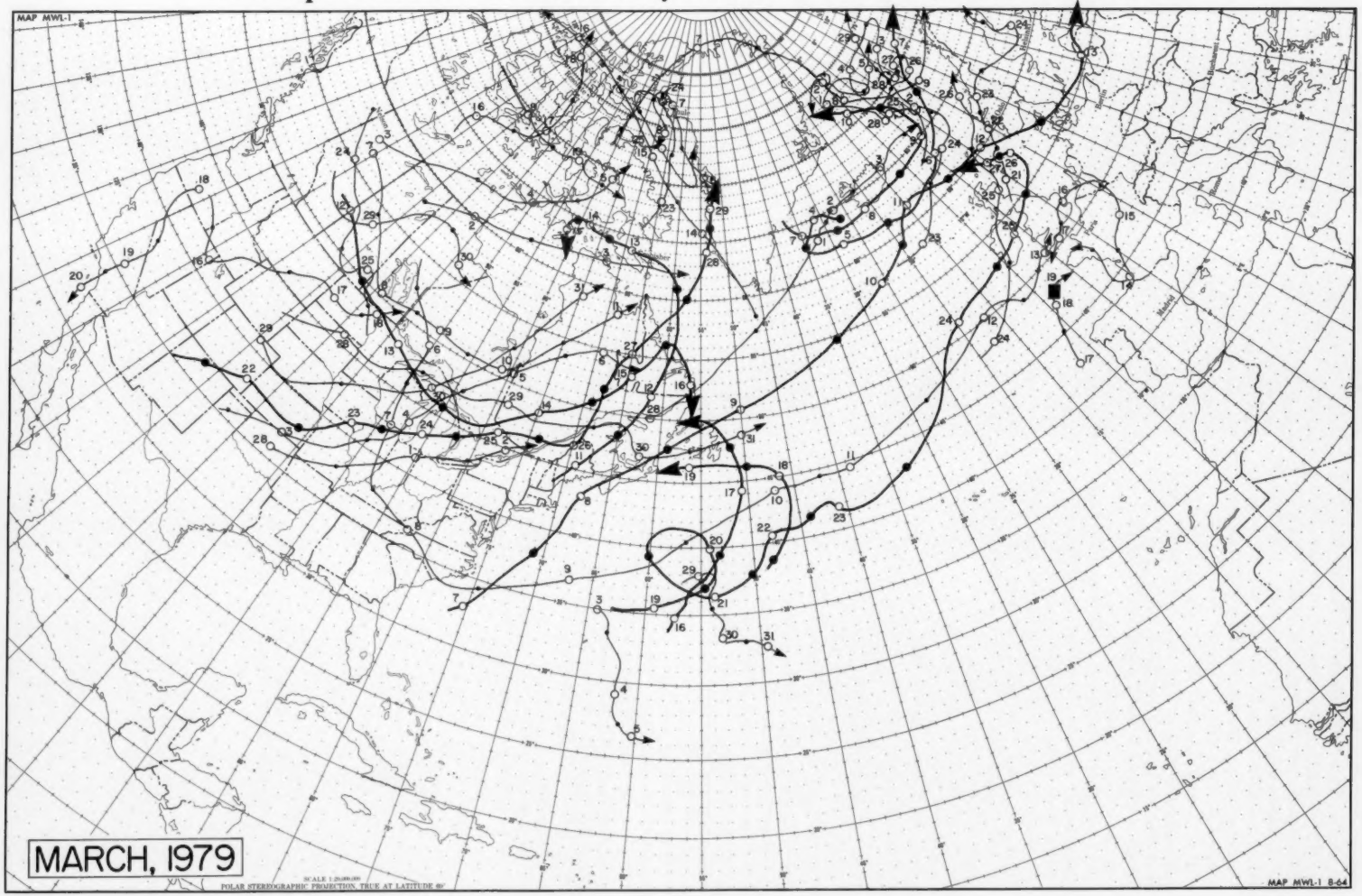


Figure 61.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

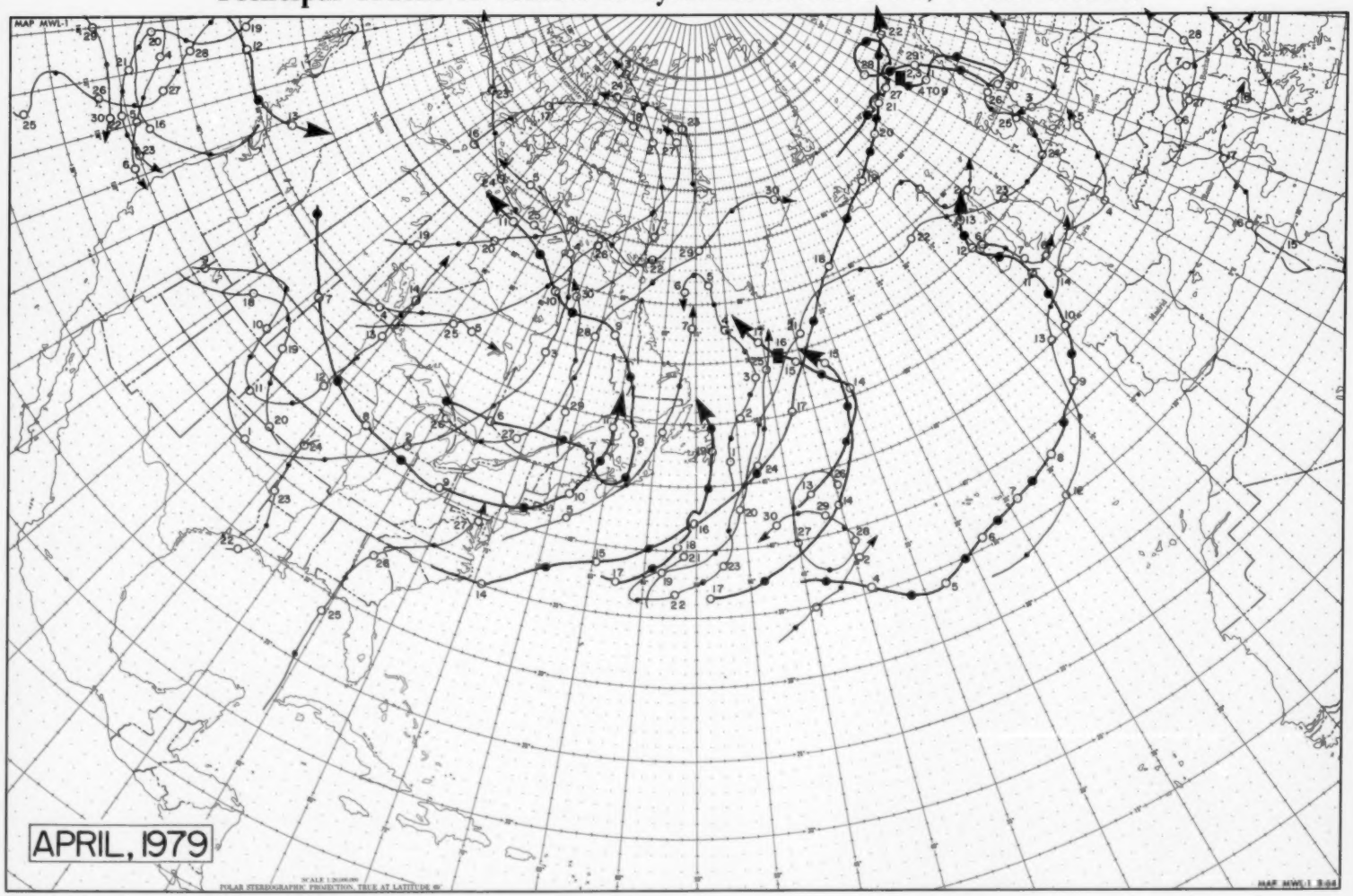


Figure 62.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

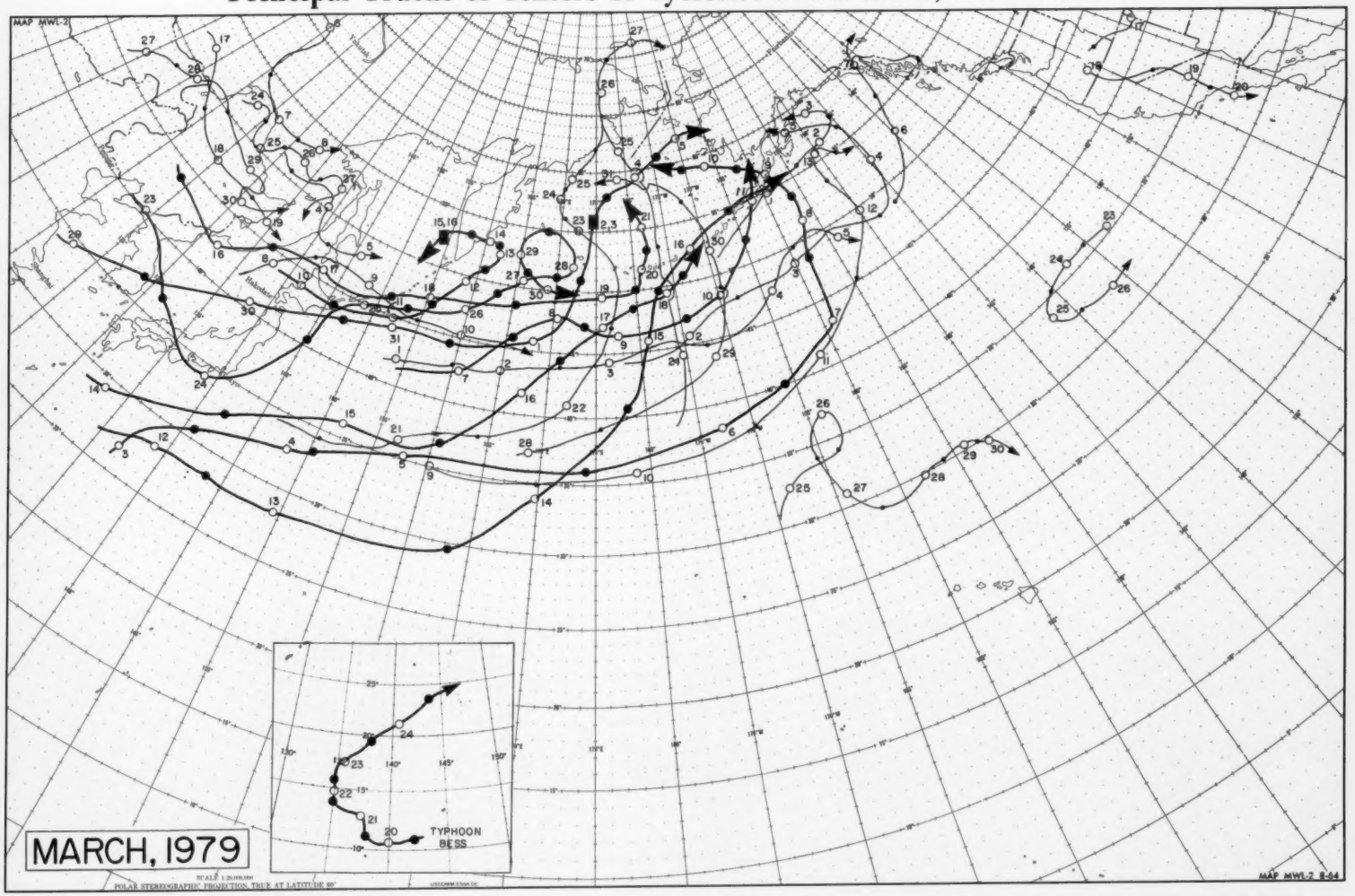


Figure 63. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

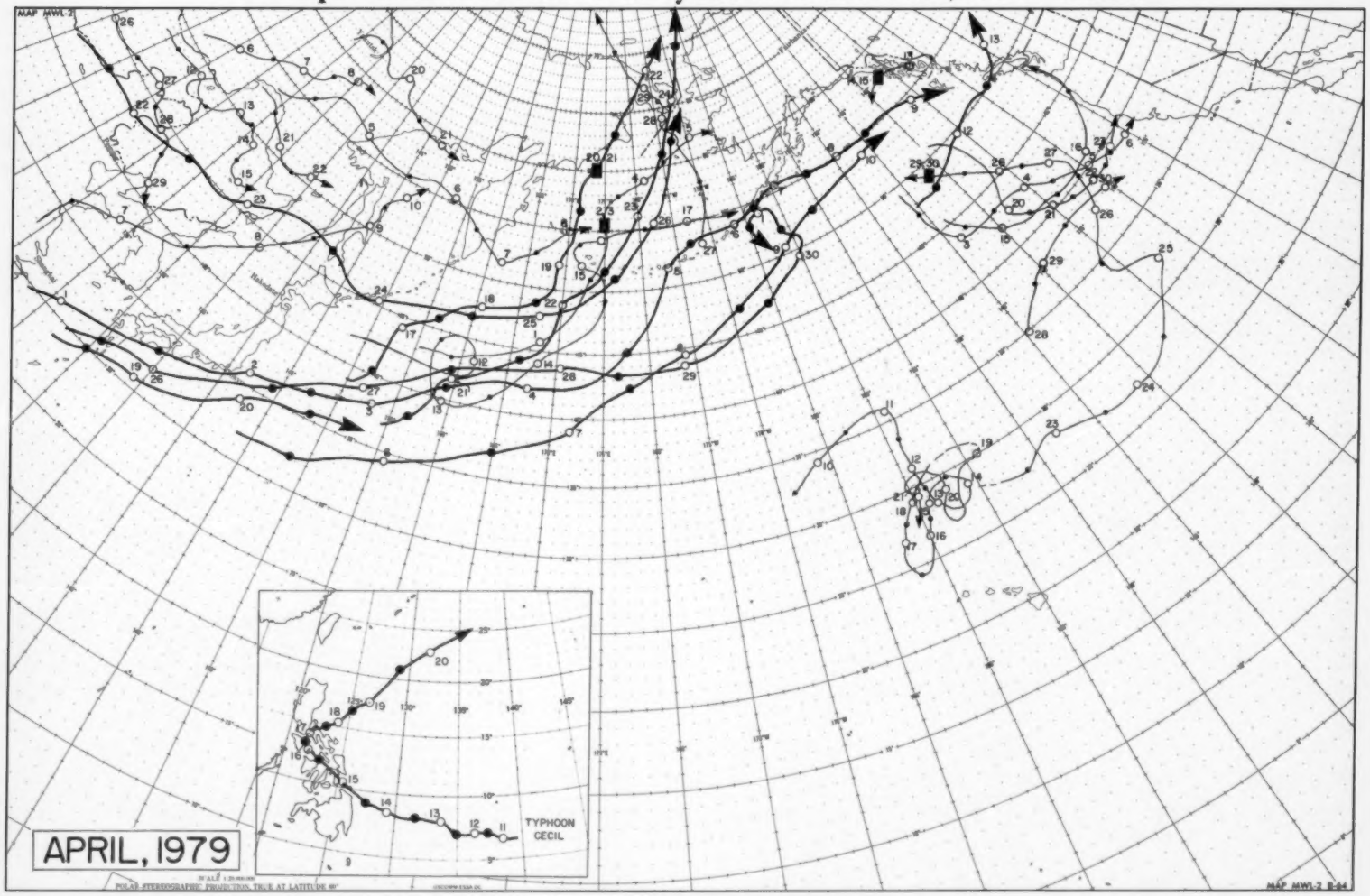


Figure 64. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 4

U.S. Ocean Buoy Climatological Data

March and April 1979

MARCH — DATA SUMMARY — 41002

AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	12.4	(18 12)	17.4	21.2	(26 03)	246	31
SEA TEMP (DEG C)	19.6	(28 09)	21.1	23.2	(30 21)	246	31
AIR-SEA TEMP (DEG C)	-00.2	(16 08)	-00.6	-02.2	(24 12)	246	31
PRESSURE (MBAR)	1001.4	(25 08)	1020.7	1034.7	(17 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		7.3	8.8				17.9	11.3
NE		3.7	4.1				7.8	10.6
E	1.6	4.9	3.7				10.2	8.1
SE		4.9	5.7				10.6	11.0
S		6.5	11.8	2.4			20.6	14.5
SW		4.9	3.7	2.4			10.6	13.6
W	.8	2.0	4.5	.8			8.1	12.8
NW	.4	2.8	6.1	1.2			10.6	14.4
CALM	.4						.4	.0
TOTAL	4.5	36.8	50.0	6.9			100.0	12.2

MAX WIND SPEED: 30 KNOTS, DIRECTION: 170 DEG, DAY: 24, HOUR: 15

MARCH — DATA SUMMARY — 41004

AVERAGE LATITUDE 32.6N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.5	(28 12)	15.9	20.7	(24 03)	244	31
SEA TEMP (DEG C)	13.3	(26 12)	16.8	21.2	(03 06)	244	31
AIR-SEA TEMP (DEG C)	-08.8	(28 13)	-01.1	03.6	(23 18)	244	31
PRESSURE (MBAR)	1000.8	(24 21)	1020.9	1038.2	(16 15)	244	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	3.7	2.0				6.9	7.8
NE	.4	6.0	9.1				15.9	9.6
E	1.2	4.8	5.3				11.4	8.4
SE	.8	2.8	2.4				6.1	8.3
S	1.6	8.4	8.8	2.0			22.8	12.3
SW	.4	2.8	3.3				6.5	11.8
W	.8	4.5	11.0				16.3	12.3
NW	.4	6.1	4.1				10.6	10.2
CALM	3.7						3.7	.0
TOTAL	10.8	45.3	44.1	2.0			100.0	10.3

MAX WIND SPEED: 28 KNOTS, DIRECTION: 180 DEG, DAY: 24, HOUR: 00

MARCH — DATA SUMMARY — 41005

AVERAGE LATITUDE 31.7N — AVERAGE LONGITUDE 079.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	18.0	(28 15)	20.0	23.1	(03 03)	28	4
SEA TEMP (DEG C)	18.1	(30 12)	19.8	21.2	(28 12)	28	4
AIR-SEA TEMP (DEG C)	-02.1	(28 19)	01.0	02.6	(31 03)	28	4
PRESSURE (MBAR)	1024.0	(31 21)	1027.8	1032.0	(03 06)	28	4

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N			3.8				3.8	10.0
NE			3.8				3.8	11.0
E								
SE								
S	3.8	23.1	50.0				76.9	11.0
SW		7.7					7.7	7.5
W		3.8	3.8				7.7	11.0
NW								
CALM								
TOTAL	3.8	38.5	57.7				100.0	10.7

MAX WIND SPEED: 16 KNOTS, DIRECTION: 170 DEG, DAY: 31, HOUR: 03

MARCH — DATA SUMMARY — 42001

AVERAGE LATITUDE 28.0N — AVERAGE LONGITUDE 080.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	18.0	(12 06)	20.4	22.7	(02 15)	240	31
SEA TEMP (DEG C)	19.5	(27 15)	20.7	22.4	(02 12)	233	31
AIR-SEA TEMP (DEG C)	-04.8	(12 06)	-00.3	01.6	(31 18)	233	31
PRESSURE (MBAR)	1007.8	(25 08)	1018.3	1025.4	(19 18)	238	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	4.2	8.4				13.0	12.4
NE		2.9	5.4	.4			8.8	12.8
E	.8	12.1	7.6				20.5	10.6
SE		19.2	13.4				32.6	9.8
S	.4	8.3	9.8				18.5	11.6
SW	.4	.4	.4				1.3	8.7
W	.8	1.7	3.5				5.0	10.7
NW	.4	3.3	2.5				6.3	10.5
CALM								
TOTAL	3.3	50.2	48.0	.4			100.0	11.0

MAX WIND SPEED: 32 KNOTS, DIRECTION: 040 DEG, DAY: 11, HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS.: 199

HEIGHT (M)	<1	1-1.5	2-3	3-4	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	7.0	59.3	32.7	2.0					1.5M	3.0M (18 18)

MARCH — DATA SUMMARY — 42002

AVERAGE LATITUDE 28.0N — AVERAGE LONGITUDE 083.5W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.8	(12 09)	18.8	22.5	(22 18)	246	31
SEA TEMP (DEG C)	19.5	(13 21)	20.5	23.0	(31 21)	246	31
AIR-SEA TEMP (DEG C)	-03.8	(04 21)	-00.9	01.7	(29 00)	246	31
PRESSURE (MBAR)	1009.1	(03 00)	1018.0	1027.0	(11 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N			3.3	3.3	1.6		8.1	13.8
NE	.8	5.3	7.7	.8			14.6	12.4
E	1.6	4.1	13.4	.8			19.9	11.8
SE	.4	9.3	27.6	.8			38.2	12.8
S	.8	1.2	2.8	.4			5.3	12.0
SW	.4	1.2	3.0				5.7	10.0
W	.4	3.3	.8				4.5	7.8
NW		1.6	4.5				6.1	12.5
CALM								
TOTAL	4.5	26.5	62.2	4.1			100.0	12.3

MARCH — DATA SUMMARY — 42003

AVERAGE LATITUDE 28.0N — AVERAGE LONGITUDE 088.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	17.5	(26 00)	21.0	25.4	(03 06)	247	31
SEA TEMP (DEG C)	24.8	(17 21)	25.5	28.2	(14 18)	247	31
AIR-SEA TEMP (DEG C)	-08.3	(12 03)	-04.5	00.1	(09 03)	247	31
PRESSURE (MBAR)	1007.4	(24 09)	1019.0	1026.6	(17 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.2	9.3	.4			10.9	14.6
NE	.4	4.0	6.1				10.5	11.9
E		8.1	28.5	.4			36.8	13.4
SE	.4	6.5	15.0	.4			22.3	14.0
S	.8	.4	2.0				3.2	12.5
SW			.4				.4	10.0
W		1.6	9.5				10.1	13.1
NW		3.6	1.8	.4			5.7	10.6
CALM								
TOTAL	1.6	25.9	70.9	1.6			100.0	13.5

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS.: 244

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	9.8	48.8	33.6	7.8					1.8M	3.5M (03 18)

APRIL — DATA SUMMARY — 41002

AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.6	(08 03)	20.0	23.3	(10 06)	235	30
SEA TEMP (DEG C)	20.2	(12 12)	22.2	25.6	(06 00)	235	30
AIR-SEA TEMP (DEG C)	-06.6	(16 18)	-02.3	01.8	(10 06)	235	30
PRESSURE (MBAR)	1002.8	(10 03)	1018.7	1028.5	(23 15)	235	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.4	1.7	11.4	.4		13.8	13.4
NE		.4	1.7	1.3	.4		3.8	10.6
E		.8	4.2	3.4			8.5	9.5
SE			4.2	5.8	2.5		10.5	15.5
S		1.3	5.1	9.3	3.8		19.4	14.0
SW			2.1	14.8	6.3		23.2	17.5
W			1.3	8.8	.8		11.0	15.7
NW			3.0	6.3	.4		9.7	13.4
CALM								
TOTAL		3.0	23.2	58.1	14.8		100.0	14.6

MAX WIND SPEED: 33 KNOTS, DIRECTION: 320 DEG, DAY: 09, HOUR: 21

APRIL — DATA SUMMARY — 41004

AVERAGE LATITUDE 32.6N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.6	(08 12)	15.8	23.6	(22 12)	237	30
SEA TEMP (DEG C)	16.7	(01 09)	20.8	27.0	(21 21)	238	30
AIR-SEA TEMP (DEG C)	-06.8	(08 18)	-01.1	03.6	(15 12)	236	30
PRESSURE (MBAR)	1002.0	(09 21)	1018.3	1027.7	(23 15)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.4	3.3	3.3	.4		7.5	11.0
NE		.8	2.5	4.2	1.3		8.8	12.4
E		1.3	2.9	3.3	1.3		8.8	12.0
SE		.4	.8	6.4	3.3	.8	11.8	19.2
S		1.7	7.1	8.8	.8		19.4	11.3
SW		.8	4.2	10.9	5.0	.8	21.3	17.0
W		.8	3.8	10.0	1.7		16.3	14.2
NW		.4	2.5	3.3			6.3	11.3
CALM		1.7					1.7	.0
TOTAL		8.4	27.2	48.0	13.8	1.7	100.0	15.8

MAX WIND SPEED: 37 KNOTS, DIRECTION: 220 DEG, DAY: 09, HOUR: 15

APRIL — DATA SUMMARY — 41005

AVERAGE LATITUDE 31.7N — AVERAGE LONGITUDE 079.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.9	(05 18)	20.0	23.8	(14 08)	228	30
SEA TEMP (DEG C)	18.0	(08 21)	20.8	23.7	(10 21)	228	30
AIR-SEA TEMP (DEG C)	-06.8	(10 12)	-00.9	03.2	(09 08)	228	30
PRESSURE (MBAR)	1002.7	(09 21)	1017.1	1029.7	(22 15)	228	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.7	3.0	2.2	.4			7.4	9.5
NE	.4	.8	3.2	2.6	.4		8.1	10.5
E		1.7	.4				2.2	9.0
SE	1.7	3.9	12.6	3.9			21.2	19.0
S	.4	6.9	8.3				15.5	12.9
SW		5.2	13.0	2.2	.9		21.2	16.3
W	2.2	4.3	8.5	.4			15.4	11.1
NW	.4	2.2	4.3	.4			7.4	12.8
CALM	1.7						1.7	.0
TOTAL	8.1	31.8	54.1	7.4	.9		100.0	13.0

MAX WIND SPEED: 38 KNOTS, DIRECTION: 220 DEG, DAY: 08, HOUR: 18

APRIL — DATA SUMMARY — 42001

AVERAGE LATITUDE 28.0N — AVERAGE LONGITUDE 080.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.0	(05 18)	18.4	22.7	(04 00)	240	30
SEA TEMP (DEG C)	19.4	(30 09)	20.8	23.0	(27 21)	237	30
AIR-SEA TEMP (DEG C)	-01.8	(30 21)	00.5	02.2	(17 00)	237	30
PRESSURE (MBAR)	1005.4	(11 09)	1014.2	1023.8	(05 18)	240	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		3.8	.8				4.8	8.8
NE		.8	2.8	1.3	.8		5.8	10.3
E		.8	10.4	14.0			25.4	12.2
SE		.8	10.4	10.8			22.1	10.7
S	1.7	10.4	19.2	1.3			32.5	12.1
SW		2.5	.4	4.8			7.7	10.8
W		2.9					2.9	7.4
NW	1.3	2.1					3.3	6.0
CALM	.4						.4	.0
TOTAL	3.4	32.5	43.8	32.2	7.4		100.0	11.1

MAX WIND SPEED: 25 KNOTS, DIRECTION: 210 DEG, DAY: 30, HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS.: 238

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	12.6	52.5	22.2	7.9					1.4M	3.5M (12 12)

APRIL — DATA SUMMARY — 42002

AVERAGE LATITUDE 28.0N — AVERAGE LONGITUDE 083.5W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	18.4	(21 18)	22.5	24.7	(28 00)	238	30
SEA TEMP (DEG C)	20.7	(08 09)	22.4	25.7	(25 21)	238	30
AIR-SEA TEMP (DEG C)	-03.4	(08 12)	-00.1	02.0	(12 12)	238	30
PRESSURE (MBAR)	1001.9	(11 09)	1013.2	1023.1	(05 15)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	2.9	.4	.4			4.2	9.8
NE		3.3	3.8	2.1			9.2	15.2
E	1.3	8.4	22.2	.8			32.8	13.1
SE	.4	9.2	21.3	.8			31.9	12.8
S	.8	5.0	3.8				9.6	9.3
SW			.4				.4	8.0
W	3.3	3.3	.4				7.1	9.0
NW	.4	3.3	.8	.4			5.0	8.4
CALM								
TOTAL	6.7	38.0	52.7	4.6			100.0	11.9

MAX WIND SPEED: 30 KNOTS, DIRECTION: 100 DEG, DAY: 30, HOUR: 03

APRIL — DATA SUMMARY — 42003

AVERAGE LATITUDE 28.0N — AVERAGE LONGITUDE 088.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	19.1	(30 03)	24.2	28.0	(14 21)	233	30
SEA TEMP (DEG C)	24.6	(02 12)	26.1	28.0	(14 18)	233	30
AIR-SEA TEMP (DEG C)	-08.4	(30 03)	-01.2	00.5	(11 21)	233	30
PRESSURE (MBAR)	1007.0	(29 09)	1018.8	1023.5	(07 03)	233	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.9	.9	1.3			3.0	7.8
NE			3.4	8.2			12.0	11.8
E		.9	10.3	15.8	.9		27.0	12.8
SE		.4	4.7	27.8			33.0	14.4
S		.4	4.3	7.7			12.4	10.8
SW		.4	1.3	.4			2.1	8.4
W			5.6	.8			6.4	8.7
NW		.9		.9			2.1	4.4
CALM							.0	.0
TOTAL		4.7	31.3	63.1	.8		100.0	12.1

MAX WIND SPEED: 22 KNOTS, DIRECTION: 110 DEG, DAY: 24, HOUR: 06

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS.: 233

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	21.0	48.4	21.0	8.0	2.6				1.5M	4.0M (24 21)

MARCH — DATA SUMMARY — 42005

AVERAGE LATITUDE 30.0N — AVERAGE LONGITUDE 085.9W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	09.6	(11 19)	16.2	18.8	(23 21)	247	31
SEA TEMP (DEG C)	13.6	(07 12)	15.5	19.5	(21 21)	247	31
AIR-SEA TEMP (DEG C)	-06.5	(26 12)	-00.3	04.3	(04 08)	247	31
PRESSURE (MBAR)	1001.2	(24 00)	1019.8	1030.9	(17 15)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.6	1.6	6.9	.4			10.5	12.0
NE	.4	3.2	1.2				4.8	11.2
E	1.2	12.6	6.5				20.2	9.2
SE	1.2	9.9	13.4	1.2			24.3	11.8
S	.8	7.7	1.9				10.4	7.7
SW	1.2	2.8	2.0	.4			6.5	9.1
W	1.6	5.3	9.3				16.2	11.5
NW	.4	2.0	4.0	.4			6.8	12.4
CALM	.4						.4	.0
TOTAL	8.8	45.7	44.8	2.4			100.0	10.8

NO. OF OBS: 247

MAX WIND SPEED: 27 KNOTS DIRECTION: 150 DEG DAY: 04 HOUR: 09

MARCH — DATA SUMMARY — 44001

AVERAGE LATITUDE 39.7N — AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	03.9	(28 19)	07.9	10.4	(31 09)	33	5
SEA TEMP (DEG C)	08.1	(28 12)	07.7	09.1	(31 00)	33	5
AIR-SEA TEMP (DEG C)	-03.6	(28 18)	00.7	03.0	(31 19)	33	5
PRESSURE (MBAR)	1018.7	(31 21)	1029.7	1039.2	(28 18)	33	5

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N			3.0				3.0	11.1
NE			6.1	6.1			12.1	9.3
E								
SE								
S	3.0	3.0	15.2				21.2	11.8
SW			9.1	21.2			30.3	12.4
W			6.1	15.2			24.2	12.3
NW			3.0	6.1			9.1	13.0
CALM								
TOTAL	3.0	30.3	88.7				100.0	11.8

NO. OF OBS: 33

MAX WIND SPEED: 17 KNOTS DIRECTION: 250 DEG DAY: 31 HOUR: 15

MARCH — DATA SUMMARY — 44002

AVERAGE LATITUDE 40.1N — AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-04.4	(18 09)	04.7	08.3	(06 15)	246	31
SEA TEMP (DEG C)	03.7	(18 09)	04.6	06.3	(31 21)	246	31
AIR-SEA TEMP (DEG C)	-08.3	(18 09)	00.1	04.8	(08 15)	246	31
PRESSURE (MBAR)	0998.8	(25 21)	1018.0	1035.4	(03 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	8.1	8.9				15.8	9.7
NE	.4	2.8	1.6				4.8	8.3
E	1.2	4.5	2.0				7.7	7.6
SE	.8	5.3	2.8				8.9	8.2
S	.8	8.5	14.6				22.0	11.5
SW	.8	6.1	4.4				11.2	10.4
W	2.4	6.1	5.7				12.2	9.6
NW	.8	5.3	11.4	1.2			18.7	13.5
CALM	1.2						1.2	0.0
TOTAL	8.9	40.7	49.6	1.2			100.0	10.5

NO. OF OBS: 246

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 5.3% SEVERE: NONE 0085: 246

MAX WIND SPEED: 24 KNOTS DIRECTION: 330 DEG DAY: 15 HOUR: 12

MARCH — DATA SUMMARY — 44003

AVERAGE LATITUDE 40.8N — AVERAGE LONGITUDE 068.9W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	01.3	(29 00)	05.1	08.4	(25 21)	76	10
SEA TEMP (DEG C)	03.8	(23 03)	04.3	04.8	(31 21)	76	10
AIR-SEA TEMP (DEG C)	-05.3	(28 18)	00.8	05.3	(26 03)	76	10
PRESSURE (MBAR)	0997.8	(29 09)	1018.6	1032.7	(29 09)	76	10

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	3.8					5.3	9.3
NE	1.3	1.3					2.8	5.0
E		3.8					3.8	7.0
SE		9.2	13.2				22.4	11.9
S	1.3	8.2	8.2				18.7	9.0
SW		6.6	1.3				7.8	8.3
W	1.3	5.3	19.8				25.7	12.1
NW		8.2	3.8				13.2	9.8
CALM	1.3						1.3	0.0
TOTAL	6.8	50.0	45.4				100.0	9.7

NO. OF OBS: 76

MAX WIND SPEED: 19 KNOTS DIRECTION: 280 DEG DAY: 29 HOUR: 09

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 72

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY		56.6	18.1	13.9	12.5				2.1M	4.5M (26 15)

MARCH — DATA SUMMARY — 44004

AVERAGE LATITUDE 39.0N — AVERAGE LONGITUDE 070.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-01.8	(18 06)	09.2	16.6	(06 15)	192	25
SEA TEMP (DEG C)	08.0	(08 12)	13.3	15.9	(12 00)	192	25
AIR-SEA TEMP (DEG C)	-15.3	(18 06)	-04.1	08.7	(06 12)	192	25
PRESSURE (MBAR)	0996.2	(11 18)	1021.7	1033.6	(17 03)	155	24

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	1.9	11.8	16.1	.8		31.1	22.2
NE		1.2	3.1	2.5			6.8	18.5
E		1.9					1.9	9.3
SE		1.2	12.4				13.6	13.3
S		1.9	8.8	9.3	1.9		19.0	21.0
SW		.8					.8	7.0
W	.8		2.5	5.0	1.2		9.3	25.0
NW		1.2	8.1	7.5			16.8	20.6
CALM	1.2						1.2	0.0
TOTAL	1.2	8.8	44.7	40.4	3.7		100.0	20.1

NO. OF OBS: 161

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 161

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY		55.5	18.2	19.1	3.1				2.0M	4.5M (22 09)

MARCH — DATA SUMMARY — 44005

AVERAGE LATITUDE 42.7N — AVERAGE LONGITUDE 068.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-07.3	(18 12)	03.9	08.2	(14 18)	239	31
SEA TEMP (DEG C)	03.2	(03 09)	04.1	07.1	(27 09)	231	31
AIR-SEA TEMP (DEG C)	-11.3	(18 12)	-01.1	04.1	(27 15)	239	31
PRESSURE (MBAR)	0980.0	(11 21)	1018.7	1037.1	(03 19)	239	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	3.3	9.6	7.5			17.6	18.6
NE		2.1	.4	1.3			3.8	15.0
E	.4	1.3	5.8				7.5	9.3
SE		1.7	3.8	2.9			8.4	15.6
S		5.4	17.2	3.3			25.8	15.5
SW	.4	2.9	3.3	1.7			8.4	14.1
W		2.9	3.8	5.4	.4		12.9	19.7
NW	.4	2.9	8.4	4.2	.4		16.4	17.1
CALM	.4						.4	.0
TOTAL	2.5	21.8	49.9	26.8	.4		100.0	16.4

NO. OF OBS: 239

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 237

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	4.2	50.1	20.3	18.6	.8				1.8M	4.0M (15 06)

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE:18.5% SEVERE: NONE 0085: 237

APRIL — DATA SUMMARY — 42005

AVERAGE LATITUDE 30.0N — AVERAGE LONGITUDE 085.9W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.4	(05 15)	20.2	23.0	(16 18)	234	30
SEA TEMP (DEG C)	17.7	(03 03)	20.2	22.7	(20 21)	234	30
AIR-SEA TEMP (DEG C)	-04.3	(27 15)	00.0	02.1	(04 18)	234	30
PRESSURE (MBAR)	1004.5	(25 21)	1018.5	1026.3	(06 15)	234	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	4.7	6.8				12.8	11.5
NE		2.6	4.9	.8			10.3	13.3
E		3.4	11.5	.8			15.8	14.4
SE		3.4	16.2	3.0			22.6	14.7
S	.8	3.8	5.0				9.6	8.8
SW	.8	4.7	6.4	.4			12.4	12.2
W		5.8	5.8				12.8	11.9
NW	.4	2.8	1.7				4.7	8.5
CALM	.8						.8	.0
TOTAL	4.3	30.8	58.4	5.6			100.0	12.5

NO. OF OBS: 234

MAX WIND SPEED: 28 KNOTS DIRECTION: 150 DEG DAY: 09 HOUR: 03

APRIL — DATA SUMMARY — 44001

AVERAGE LATITUDE 39.7N — AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	02.4	(07 19)	08.6	12.1	(27 03)	238	30
SEA TEMP (DEG C)	07.4	(07 09)	07.8	10.0	(30 21)	238	30
AIR-SEA TEMP (DEG C)	-04.6	(06 19)	00.8	03.7	(27 03)	238	30
PRESSURE (MBAR)	0980.4	(09 21)	1018.8	1029.5	(11 15)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	5.8	7.6	.8			14.7	12.5
NE		4.6	1.7	.4			6.7	9.2
E		9.5	5.9	1.3			16.7	13.2
SE	.4	1.7	2.9	1.7			6.7	14.6
S	.8	7.1	6.7				14.7	9.8
SW	.8	6.7	3.8	1.3			12.6	11.8
W	1.3	7.8	2.5	.8			12.2	8.4
NW	1.3	8.2	9.5	5.0	.4		32.3	14.7
CALM	1.7						1.7	.0
TOTAL	6.7	46.4	39.3	12.2	.4		100.0	11.8

NO. OF OBS: 238

MAX WIND SPEED: 34 KNOTS DIRECTION: 320 DEG DAY: 07 HOUR: 03

APRIL — DATA SUMMARY — 44002

AVERAGE LATITUDE 40.1N — AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	01.8	(08 15)	07.1	12.5	(24 09)	238	30
SEA TEMP (DEG C)	04.7	(07 12)	06.2	09.5	(30 21)	238	30
AIR-SEA TEMP (DEG C)	-02.8	(08 09)	00.9	04.6	(24 09)	238	30
PRESSURE (MBAR)	0988.5	(10 00)	1018.0	1027.6	(11 15)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	7.1	2.8				10.5	8.3
NE	.4	2.5	2.1				5.0	8.8
E	.4	1.7	11.7	.8			14.6	16.2
SE		2.5	1.7				4.2	10.0
S	.8	8.8	5.4	.8			15.8	9.0
SW	.8	4.2	4.6				11.3	8.4
W		10.8	5.0	1.3			17.2	9.8
NW	.8	8.2	7.1	2.9			20.1	12.4
CALM	4.2						4.2	.0
TOTAL	4.2	46.0	41.0	5.9			100.0	11.1

NO. OF OBS: 239

MAX WIND SPEED: 27 KNOTS DIRECTION: 300 DEG DAY: 07 HOUR: 06

APRIL — DATA SUMMARY — 44003

AVERAGE LATITUDE 40.8N — AVERAGE LONGITUDE 068.9W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	01.8	(08 18)	05.7	11.6	(28 09)	231	30
SEA TEMP (DEG C)	04.3	(08 21)	06.1	08.3	(25 18)	231	30
AIR-SEA TEMP (DEG C)	-02.8	(08 15)	00.1	05.3	(10 03)	231	30
PRESSURE (MBAR)	0993.8	(10 06)	1018.2	1029.2	(22 12)	231	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		6.1	5.2	.9			12.1	11.1
NE	.4	4.3	10.8				15.8	12.8
E	1.3	3.2	7.4	.4			11.3	13.7
SE		3.5	1.7				5.2	10.3
S	.4	5.6	6.1	.9			12.8	11.6
SW	.4	3.0	1.3				4.8	8.9
W	.4	9.1	10.0	4.3			23.8	13.6
NW		3.0	9.6	1.3			14.0	14.4
CALM	1.3						1.3	0.0
TOTAL	3.0	39.1	64.1	7.8			100.0	12.8

NO. OF OBS: 231

MAX WIND SPEED: 28 KNOTS DIRECTION: 280 DEG DAY: 07 HOUR: 15

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 210

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY		7.6	47.6	28.1	11.0	5.2			1.8M	5.5M (10 00)

APRIL — DATA SUMMARY — 44004

AVERAGE LATITUDE 39.0N — AVERAGE LONGITUDE 070.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	04.3	(07 18)	12.2	22.4	(25 15)	210	28
SEA TEMP (DEG C)	12.4	(07 18)	15.8	19.8	(03 15)	210	28
AIR-SEA TEMP (DEG C)	-09.3	(08 15)	-03.6	09.2	(25 15)	210	28
PRESSURE (MBAR)	0984.8	(10 03)	1017.2	1028.7	(22 15)	210	28

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 210

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	9.5	50.7	28.0	11.0	0.8				1.0M	5.5M (07 09)

APRIL — DATA SUMMARY — 44005

AVERAGE LATITUDE 42.7N — AVERAGE LONGITUDE 068.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	00.4	(07 06)	04.8	09.5	(24 03)	227	30
SEA TEMP (DEG C)	04.3	(02 12)	04.9	07.1	(30 21)	227	30
AIR-SEA TEMP (DEG C)	-04.3	(27 06)	-00.3	03.6	(10 03)	227	30
PRESSURE (MBAR)	0982.0	(10 06)	1015.9	1031.4	(03 12)	226	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		6.1	6.1	.4			12.7	11.2
NE	.8	5.3	4.8	.0			11.0	11.1
E		3.5	6.6	.0			10.2	11.4
SE		2.6	3.8	2.6			9.2	16.1
S		5.3	9.1	3.7			17.1	16.6
SW		1.8	5.7				7.5	11.7
W		6.1	4.8	6.1	.4		17.9	17.7
NW		5.7	6.1	1.8			13.6	12.8
CALM	.4						.4	.0
TOTAL	1.3	36.4	48.6	13.3	.4		100.0	14.2

NO. OF OBS: 238

MAX WIND SPEED: 34 KNOTS DIRECTION: 280 DEG DAY: 07 HOUR: 15

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 229

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	18.8	53.3	23.2	4.0	.4				1.5M	4.0M (07 00)

MARCH — DATA SUMMARY — 46001

AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	01.2	(07 00)	03.2	05.0	(08 21)	247	31
SEA TEMP (DEG C)	03.5	(07 18)	03.8	04.3	(30 00)	247	31
AIR-SEA TEMP (DEG C)	-02.4	(07 00)	-00.6	01.3	(08 21)	247	31
PRESSURE (MBAR)	0984.3	(04 21)	1008.1	1040.2	(24 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 247
N			1.2				1.2	6.0	SPEED: 41 KNOTS
E			1.6	3.6	4.9	1.6	11.7	22.7	DIRECTION: 090 DEG
SE			1.6	5.5	0.1	.4	7.6	20.9	DAY: 08
S			1.2	10.9	3.6	.4	16.1	18.8	HOUR: 06
SW			.4	10.1	3.2		13.9	18.2	
W		.4	2.8	10.8	3.2		17.3	17.5	
NW			1.2	5.3	4.0		10.5	18.4	
CALM									
TOTAL		.4	10.1	59.1	32.0	2.4	100.0	18.8	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 248

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	5-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		32.8	41.9	22.8	11.4	1.2			2.6M	6.5M	(09 09)

MARCH — DATA SUMMARY — 46002

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	06.2	(26 12)	08.7	12.3	(04 00)	247	31
SEA TEMP (DEG C)	11.0	(26 21)	11.5	12.3	(25 00)	247	31
AIR-SEA TEMP (DEG C)	-05.2	(26 12)	-02.8	00.7	(04 00)	247	31
PRESSURE (MBAR)	0998.1	(27 12)	1018.9	1037.8	(31 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 247
N		.4	4.8	10.9	13.4		29.1	18.8	MAX WIND
NE		.8	4.5	6.2	.8		13.4	12.4	SPEED: 32 KNOTS
E			3.2	4.9			7.7	11.5	DIRECTION: 380 DEG
SE		.4		.4			.8	9.5	DAY: 27
S			1.2	4.5	4.5		10.1	19.8	HOUR: 21
SW			1.2	6.7	3.4		11.3	17.0	
W			4.0	6.5	.4		11.7	12.8	
NW		.4	2.8	8.9	1.2		13.4	14.5	
CALM		.4					.4	0	
TOTAL		2.4	23.5	51.4	23.7		100.0	16.7	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 244

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	5-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY			8.2	55.7	32.0	4.1			2.8M	4.9M	(09 21)

MARCH — DATA SUMMARY — 46003

AVERAGE LATITUDE 52.0N — AVERAGE LONGITUDE 158.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	00.8	(13 18)	03.3	05.8	(31 21)	247	31
SEA TEMP (DEG C)	03.4	(13 15)	03.7	04.1	(31 21)	247	31
AIR-SEA TEMP (DEG C)	-02.8	(12 18)	-00.4	01.8	(21 06)	247	31
PRESSURE (MBAR)	0960.0	(26 12)	1004.1	1037.4	(24 06)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 247
N		.8	.8	1.6			3.2	19.3	MAX WIND
NE		.8	2.4	1.2			4.4	7.3	SPEED: 34 KNOTS
E		.8	2.8	2.4	1.2	.4	7.7	14.4	DIRECTION: 080 DEG
SE			2.0	8.3			11.3	14.0	DAY: 07
S		.4	4.0	12.6	4.5		21.5	15.3	HOUR: 21
SW		.4	6.5	13.4	4.0		24.3	14.4	
W		.4	6.1	8.1	3.6		18.4	14.9	
NW			.8	1.6	5.3		7.7	22.7	
CALM		.4					.4	.0	
TOTAL		3.2	25.5	50.8	20.2	.4	100.0	15.0	

MARCH — DATA SUMMARY — 46004

AVERAGE LATITUDE 51.0N — AVERAGE LONGITUDE 136.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	02.3	(15 18)	06.1	08.4	(05 15)	247	31
SEA TEMP (DEG C)	09.0	(16 12)	09.4	10.0	(04 15)	247	31
AIR-SEA TEMP (DEG C)	-05.8	(15 18)	-00.3	02.4	(05 15)	247	31
PRESSURE (MBAR)	0977.8	(24 18)	1014.4	1039.5	(24 18)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 247
N		.4	1.2	8.9	11.3		21.9	20.8	MAX WIND
NE		.4					.4	3.0	SPEED: 42 KNOTS
E			.8	.4			1.2	10.0	DIRECTION: 310 DEG
SE			.8	1.2	10.9	.8	13.9	20.4	DAY: 04
S		.4	1.6	14.2	10.9	.4	27.5	18.9	HOUR: 21
SW			1.2	4.0	2.8	.4	8.3	18.4	
W			2.4	7.7	4.0	.8	14.9	18.1	
NW			.8	4.0	7.3		12.1	19.8	
CALM									
TOTAL		1.2	8.5	40.8	47.0	2.4	100.0	20.6	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY			5.7	43.3	32.8	17.4	.8		3.0M	8.0M	(18 06)

MARCH — DATA SUMMARY — 46005

AVERAGE LATITUDE 46.0N — AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	05.5	(26 09)	08.0	10.8	(04 15)	247	31
SEA TEMP (DEG C)	08.4	(03 12)	08.9	09.8	(04 15)	247	31
AIR-SEA TEMP (DEG C)	-03.4	(24 09)	-00.9	01.8	(04 15)	247	31
PRESSURE (MBAR)	1000.0	(04 15)	1017.5	1036.6	(31 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 247
N			4.8	17.4	7.7		30.0	16.6	MAX WIND
NE			1.6	2.8			4.4	11.9	SPEED: 32 KNOTS
E				1.2			1.2	13.7	DIRECTION: 350 DEG
SE			2.8	4.9	.8		8.5	14.0	DAY: 21
S			2.4	5.3	7.3		15.0	18.5	HOUR: 18
SW		.8	4.0	5.3	.8		12.1	12.9	
W			2.8	7.7			10.5	13.1	
NW			4.0	13.4			17.4	14.8	
CALM									
TOTAL		.8	22.1	60.8	16.8		100.0	15.4	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY			6.1	53.8	23.9	8.5			2.9M	4.9M	(22 00)

MARCH — DATA SUMMARY — 46006

AVERAGE LATITUDE 41.0N — AVERAGE LONGITUDE 139.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	07.6	(27 09)	10.4	13.4	(05 21)	248	31
SEA TEMP (DEG C)	10.7	(26 12)	11.3	12.0	(31 00)	248	31
AIR-SEA TEMP (DEG C)	-03.8	(26 12)	-00.8	02.1	(05 21)	248	31
PRESSURE (MBAR)	1004.0	(04 09)	1020.2	1039.9	(31 21)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 248
N		1.2	2.4	11.3	5.2		20.2	17.1	
NE				4.8	7.3		12.1	21.0	MAX WIND
E		.4	2.0				2.4	9.2	SPEED: 41 KNOTS
SE		.4	3.2	3.6	.8		8.1	12.7	DIRECTION: 190 DEG
S			1.2	4.8	8.5		14.5	19.6	DAY: 08
SW			1.2	8.5	5.2		14.9	18.6	HOUR: 03
W			1.2	7.7	3.4		13.3	18.0	
NW			1.2	8.9	2.8		13.7	18.6	
CALM		.4					.4	.0	
TOTAL		2.4	13.7	49.8	34.3		100.0	18.0	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 248

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY			9.2	40.3	42.7	11.7			2.9M	5.0M	(05 09)

APRIL — DATA SUMMARY — 46001

AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	01.8	(13 12)	03.8	05.5	(30 21)	239	30
SEA TEMP (DEG C)	04.0	(03 18)	04.7	05.8	(04 09)	239	30
AIR-SEA TEMP (DEG C)	-02.7	(13 12)	-01.0	00.4	(04 09)	239	30
PRESSURE (MBAR)	0987.8	(07 12)	1017.5	1036.2	(21 12)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 238
N		1.7	3.8	.8			6.4	6.4	MAX WIND
NE			1.3	2.5			3.8	8.2	SPEED: 36 KNOTS
E		.4	2.5	5.8	.4		9.3	13.3	DIRECTION: 130 DEG
SE		1.3	2.9	9.1	1.3	.4	15.2	13.8	DAY: 06
S		.4	4.7	10.2			15.3	12.6	HOUR: 15
SW		.4	3.0	7.8	.8		11.9	13.8	
W		3.0	3.8	24.2			31.1	13.7	
NW		1.3	3.8	8.9			13.8	11.7	
CALM									
TOTAL		6.9	26.0	69.1	2.9	.4	100.0	12.5	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 237

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		.8	60.8	20.7	7.2	2.5			1.7M	4.9M	(09 00)

APRIL — DATA SUMMARY — 46002

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	06.3	(17 21)	10.3	15.3	(30 00)	238	30
SEA TEMP (DEG C)	11.3	(18 18)	11.8	14.1	(30 00)	238	30
AIR-SEA TEMP (DEG C)	-05.2	(17 21)	-01.5	02.0	(27 00)	238	30
PRESSURE (MBAR)	1003.3	(27 12)	1019.1	1037.2	(01 06)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 238
N		.8	5.1	5.9	2.1		14.0	13.2	MAX WIND
NE		.8	2.1	5.1	.8		8.8	13.8	SPEED: 32 KNOTS
E		1.3	3.4	8.8	1.3		12.7	13.9	DIRECTION: 020 DEG
SE			2.1	5.8	1.3		9.2	14.4	DAY: 18
S		.8	3.8	3.0	.8		8.8	11.8	HOUR: 19
SW		.4	3.4	9.1	2.1		15.1	15.2	
W		.4	3.0	8.3	5.8		18.8	17.3	
NW		.4	2.1	14.4	1.7		18.6	16.3	
CALM		.4					.4	0	
TOTAL		3.8	26.7	61.7	18.1		100.0	14.4	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 235

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		.8	43.4	32.3	18.8	4.0	.9		2.1M	6.5M	(13 06)

APRIL — DATA SUMMARY — 46003

AVERAGE LATITUDE 52.0N — AVERAGE LONGITUDE 158.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	03.0	(02 18)	04.2	05.8	(30 03)	238	30
SEA TEMP (DEG C)	03.8	(09 18)	04.4	05.0	(30 03)	238	30
AIR-SEA TEMP (DEG C)	-02.5	(02 18)	-00.3	01.7	(03 21)	238	30
PRESSURE (MBAR)	1007.4	(07 00)	1018.8	1037.7	(22 06)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 238
N			2.9	.8			3.8	9.4	MAX WIND
NE		.8	2.1	2.1			5.0	9.4	SPEED: 32 KNOTS
E			.8	1.7			2.5	14.0	DIRECTION: 150 DEG
SE			3.3	5.9	2.9		12.1	15.8	DAY: 08
S		.4	8.2	21.8	2.5		33.0	15.1	HOUR: 03
SW		.4	5.0	14.6	.8		20.9	13.3	
W			3.3	10.0			13.3	12.0	
NW			4.2	6.3	1.3		11.7	13.1	
CALM		.4					.4	.0	
TOTAL		2.1	30.5	59.8	7.5		100.0	13.0	

APRIL — DATA SUMMARY — 46004

AVERAGE LATITUDE 51.0N — AVERAGE LONGITUDE 136.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	03.1	(16 09)	06.1	08.2	(26 00)	240	30
SEA TEMP (DEG C)	08.7	(16 09)	09.1	09.7	(30 03)	240	30
AIR-SEA TEMP (DEG C)	-03.4	(15 09)	-00.8	01.0	(30 03)	240	30
PRESSURE (MBAR)	0988.8	(12 12)	1018.2	1033.3	(01 00)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 240
N		.4	5.4	20.8	2.5	.8	30.0	16.1	MAX WIND
NE			2.1	5.4			7.5	13.8	SPEED: 47 KNOTS
E		.4	4.2	7.5	.8	.8	13.8	15.1	DIRECTION: 070 DEG
SE		.4	.8	5.4			6.7	12.1	DAY: 12
S		.4	1.7	8.8	1.7	.4	13.0	16.4	HOUR: 12
SW			2.1	10.0			12.1	13.7	
W			1.7	8.8	1.7		12.1	16.4	
NW			2.9	5.4	2.9		11.2	16.8	
CALM		.4					.4	.0	
TOTAL		2.1	20.8	85.0	8.8	2.1	100.0	15.2	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 240

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY			55.0	30.4	9.6	5.0			1.9M	5.0M	(12 18)

APRIL — DATA SUMMARY — 46005

AVERAGE LATITUDE 46.0N — AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	05.6	(10 12)	08.6	11.7	(05 18)	240	30
SEA TEMP (DEG C)	08.5	(15 12)	09.0	11.3	(30 00)	240	30
AIR-SEA TEMP (DEG C)	-03.2	(10 12)	-00.4	02.5	(05 18)	240	30
PRESSURE (MBAR)	0984.3	(13 18)	1018.3	1035.6	(01 00)	240	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 240
N		1.3	4.2	8.2			14.6	13.0	MAX WIND
NE		.4	2.1	7.5	.4		10.8	14.5	SPEED: 47 KNOTS
E		.4	1.3	3.3			5.0	14.2	DIRECTION: 240 DEG
SE			1.7	3.3			5.0	11.4	DAY: 12
S		.8	4.2	2.1	3.3		10.4	13.6	HOUR: 18
SW		.4	3.3	2.1	.8		7.5	13.4	
W		.4	7.5	11.7	4.2	1.3	25.0	15.7	
NW		.4	5.0	10.0	2.1		17.9	14.3	
CALM									
TOTAL		4.2	29.2	53.8	10.8	2.1	100.0	14.2	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 240

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		.8	57.1	27.1	10.0	2.5			1.9M	6.5M	(12 21)

APRIL — DATA SUMMARY — 46006

AVERAGE LATITUDE 41.0N — AVERAGE LONGITUDE 139.0W

MEANS AND EXTREMES

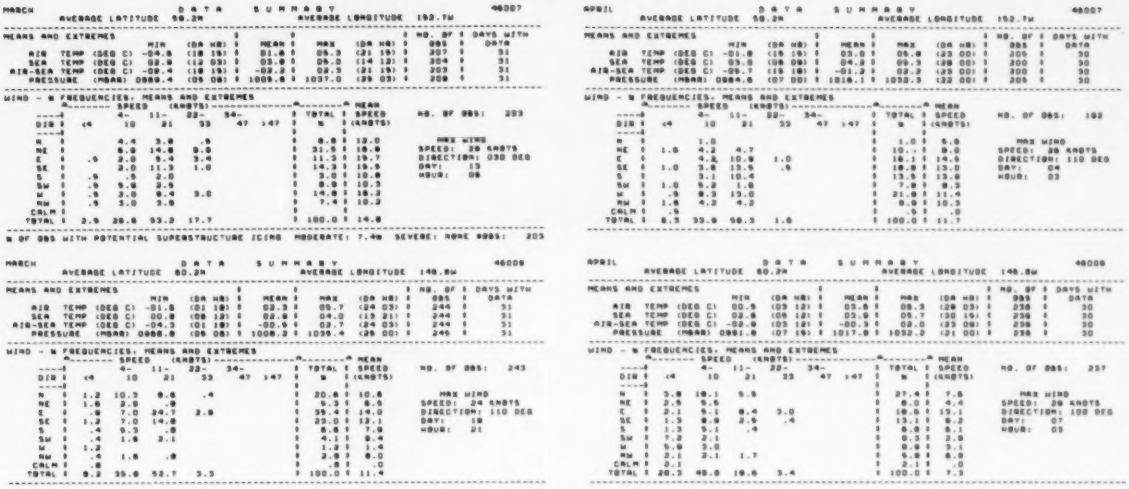
	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	09.6	(28 18)	10.3	12.7	(12 09)	240	30
SEA TEMP (DEG C)	10.7	(28 18)	11.4	13.3	(09 00)	240	30
AIR-SEA TEMP (DEG C)	-05.7	(30 18)	-01.3	01.1	(13 06)	240	30
PRESSURE (MBAR)	1007.2	(28 15)	1021.9	1039.3	(01 06)	240	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

SPEED (KNOTS)						MEAN	
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	SPEED (KNOTS)	NO. OF OBS: 240
N			2.1	11.7	4.2		17.9	17.0	MAX WIND
NE			.8	5.4	5.4		11.7	18.9	SPEED: 38 KNOTS
E							1.7	13.3	DIRECTION: 090 DEG
SE			2.5	1.7			4.2	9.5	DAY: 26
S		1.3	2.1	1.7			5.0	11.2	HOUR: 19
SW			3.8	8.3	1.7		13.7	14.2	
W		.4	3.3	20.8	1.3		25.8	14.8	
NW			3.8	14.2	1.7		19.7	14.0	
CALM		1.3					1.3	.0	
TOTAL		3.8	18.8	64.8	13.8		100.0	14.8	

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 240

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	1.3	36.3	40.8	13.8	7.9				2.2M	4.9M	(28 18)



MARCH DATA SUMMARY 46007
AVERAGE LATITUDE 50.2N AVERAGE LONGITUDE 152.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-04.5	(18 15)	01.4	09.3	(21 19)	207	31
SEA TEMP (DEG C)	02.5	(12 03)	03.9	06.0	(14 12)	204	31
AIR-SEA TEMP (DEG C)	-09.4	(18 15)	-02.2	00.5	(21 15)	203	31
PRESSURE (MBAR)	0969.4	(05 08)	1009.8	1037.0	(28 05)	208	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS)					TOTAL	MEAN SPEED (KNOTS)	
DIR	<4	4-10	11-21	22-33	34-47	>47	N	
N		4.4	3.8	.5			8.8	12.0
NE		6.0	14.8	9.8			31.4	15.8
E	.5	2.8	5.4	3.4			11.5	13.7
SE		2.0	11.3	1.0			14.3	13.5
S	.5		2.0				3.0	10.8
SW	.5	5.8	2.5				8.8	10.3
W	.5	2.0	8.4	3.8			14.8	15.2
NW	.5	3.0	3.8				7.4	10.2
CALM								
TOTAL	2.5	26.0	53.2	17.7			100.0	14.8

MAX WIND
SPEED: 48 KNOTS
DIRECTION: 030 DEG
DAY: 13
HOUR: 09

NO. OF OBS: 203

N OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 7.4% SEVERE: NONE OBS: 203

APRIL DATA SUMMARY 46007
AVERAGE LATITUDE 50.2N AVERAGE LONGITUDE 152.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-01.8	(15 19)	03.0	06.8	(23 00)	205	30
SEA TEMP (DEG C)	03.8	(08 09)	04.9	06.3	(28 00)	200	30
AIR-SEA TEMP (DEG C)	-05.7	(15 18)	-01.2	02.2	(23 00)	200	30
PRESSURE (MBAR)	0984.6	(07 00)	1018.1	1038.2	(22 00)	205	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS)					TOTAL	MEAN SPEED (KNOTS)	
DIR	<4	4-10	11-21	22-33	34-47	>47	N	
N		1.0					1.0	5.8
NE	1.0	4.2	4.7				10.0	9.0
E		4.4	10.9	1.0			16.1	14.5
SE	1.0	3.8	13.9	.9			19.8	13.8
S		3.1	10.4				13.5	13.9
SW	1.0	5.2	1.0				7.3	8.5
W	.9	8.3	13.0				21.9	11.4
NW	1.8	4.2	4.2				9.9	10.5
CALM	.5						.5	.0
TOTAL	5.3	33.9	58.3	1.8			100.0	11.7

MAX WIND
SPEED: 39 KNOTS
DIRECTION: 110 DEG
DAY: 04
HOUR: 02

NO. OF OBS: 192

MARCH DATA SUMMARY 46006
AVERAGE LATITUDE 50.2N AVERAGE LONGITUDE 148.8W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-01.8	(01 18)	03.3	09.7	(24 03)	244	31
SEA TEMP (DEG C)	00.8	(08 12)	02.8	04.0	(23 21)	244	31
AIR-SEA TEMP (DEG C)	-04.3	(01 18)	-00.9	02.7	(24 03)	244	31
PRESSURE (MBAR)	0988.8	(05 08)	1008.2	1035.4	(25 00)	245	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS)					TOTAL	MEAN SPEED (KNOTS)	
DIR	<4	4-10	11-21	22-33	34-47	>47	N	
N	1.2	10.3	8.8	.4			20.8	10.8
NE	1.6	2.9	.8				5.3	8.5
E	.8	7.0	24.7	2.8			35.4	14.0
SE	1.2	7.0	14.8				23.0	12.1
S	.4	5.3	.8				6.6	7.9
SW	.4	1.6	2.1				4.1	8.4
W	1.2						1.2	1.4
NW	.4	1.6	.8				2.8	8.0
CALM	.8						.8	.0
TOTAL	8.2	35.8	52.7	3.3			100.0	11.4

MAX WIND
SPEED: 24 KNOTS
DIRECTION: 110 DEG
DAY: 19
HOUR: 21

NO. OF OBS: 243

APRIL DATA SUMMARY 46006
AVERAGE LATITUDE 50.2N AVERAGE LONGITUDE 148.8W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	00.5	(09 12)	03.8	08.3	(28 03)	238	30
SEA TEMP (DEG C)	02.8	(09 12)	03.9	05.7	(30 15)	238	30
AIR-SEA TEMP (DEG C)	-02.8	(03 12)	-00.3	02.8	(25 09)	238	30
PRESSURE (MBAR)	0981.8	(07 00)	1017.8	1032.2	(21 00)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS)					TOTAL	MEAN SPEED (KNOTS)	
DIR	<4	4-10	11-21	22-33	34-47	>47	N	
N	3.8	18.1	5.5				27.4	7.8
NE	2.5	5.5					8.0	4.4
E	2.1	9.1	8.4	3.0			18.8	13.1
SE	1.3	9.8	2.5	.4			13.1	8.2
S	1.3	5.1	.4				6.8	6.1
SW	7.2	2.1					9.3	2.9
W	5.9	3.0					8.9	3.1
NW	2.1	2.1	1.7				5.9	6.0
CALM	2.1						2.1	.0
TOTAL	28.3	40.8	18.6	3.4			100.0	7.3

MAX WIND
SPEED: 28 KNOTS
DIRECTION: 100 DEG
DAY: 07
HOUR: 03

NO. OF OBS: 237

Table 5

Selected Gale and Wave Observations, North Atlantic

March and April 1979

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec.	Sea Waves* Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH ATLANTIC OCEAN		MAR.															
CHARLES PIGOTT	LIBERIAN	11	27.8 N	16.1 W	18	02	M 44	10 NM	02	1020.5	18.0	18.9	7	19.5			
TARIN MAERSK	DANISH	12	39.3 N	64.2 W	00	19	45	2 NM	07	996.0	18.5		10	18			
PIONEER COMMANDER	AMERICAN	13	34.2 N	67.7 W	00	29	45	10 NM	03	1021.0	11.7	19.4	3	6.5	29	8	11.5
LIGHTNING	AMERICAN	14	36.7 N	09.8 W	12	34	50	5 NM	02	1010.5	12.3	15.0			33	6	13
CHALLENGER	LIBERIAN	16	41.2 N	20.2 W	00	32	42	5 NM	02	1017.6	9.5	13.0	7	10	34	10	13
EL PASO ARZEW	AMERICAN	16	36.5 N	55.2 W	22	34	M 60	1 NM	81	1012.0	12.5	16.1	10	19.5			
KENSHO MARU	JAPANESE	17	39.1 N	53.7 W	00	34	M 45	2 NM	03	1013.5	10.5	18.0	4	6.5	35	7	13
MARIA TOPIC	LIBERIAN	20	41.0 N	57.0 W	06	03	41	5 NM	00	990.5	9.0	16.0	7	13			
DALAMAN	TURKISH	20	29.5 N	53.1 W	12	27	45	5 NM	04	1007.7	17.5	20.0	7	29.5			
DALAMAN	TURKISH	21	28.7 N	58.6 W	12	27	45	5 NM	07	1005.6	20.0	20.0	7	14.5			
J R GREY	LIBERIAN	22	42.7 N	10.1 W	18	18	M 45	2 NM	02	1010.0	12.0	12.0	6	10			
ALBA STEPHENS	AMERICAN	23	36.5 N	40.3 W	18	26	42	10 NM	02	998.0	17.8	17.3	5	6.5	26	9	14.5
AMER CORSAIR	AMERICAN	24	48.7 N	18.7 W	18	02	41	2 NM	91		7.2	11.7	9	19.5	02	>13	23
AMER ACCORD	AMERICAN	24	49.5 N	23.5 W	18	01	45	5 NM	15	1000.0	11.1	10.6	7	28			
AMER CORSAIR	AMERICAN	25	48.0 N	19.7 W	00	36	45	5 NM	90	994.0	7.8	11.7	4	16.5	02	7	19.5
ALBA STEPHENS	AMERICAN	26	36.5 N	61.3 W	18	17	65	2 NM	80	1009.1	17.3	18.8	4	11.5	17	9	16.5
CHALLENGER	LIBERIAN	29	48.0 N	06.6 W	12	34	51	10 NM	03	1011.0	10.0	8.5	9	19.5	34	12	23
GREAT LAKES VESSELS																	
JOHN G MUNSON	AMERICAN	24	45.3 N	86.4 W	18	36	M 42	10 NM	00		- 7.0	2.0		3			
NORTH ATLANTIC OCEAN		APR.															
BERGLJOT	NORWEGIAN	4	38.8 N	46.9 W	00	01	M 44	5 NM	02	1006.0	13.0	17.0	11	19.5			
EL PASO ARZEW	AMERICAN	4	34.1 N	44.9 W	12	33	M 35	1 NM	16	1007.0	17.0	16.7	6	10	31	10	26
ARELIBD	AMERICAN	9	34.8 N	71.4 W	18	20	45	5 NM	03	1006.1	22.5	22.5	2	10	20	< 6	14.5
DYVI KATTEGAT	NORWEGIAN	9	36.6 N	69.4 W	18	20	45	5 NM	02	1003.5	19.5	24.0					
DYVI KATTEGAT	NORWEGIAN	10	39.8 N	61.5 W	18	18	45	5 NM	07	1004.4	18.0	18.0	10	16.5			
ARELIBD	AMERICAN	10	34.3 N	71.4 W	00	20	45	5 NM	02	1006.4	18.9	23.4	2	10	20	< 6	14.5
SNOW LAND	SWEDISH	10	34.7 N	73.5 W	00	19	45	.5 NM	81	1000.0	20.0	24.6					
GUAYAMA	AMERICAN	10	37.8 N	63.0 W	23	27	40	2 NM	02	1009.0	20.0	18.0	8	28	26	9	32.5
GUAYAMA	AMERICAN	11	38.4 N	65.1 W	06	27	40	2 NM	02	1006.0	20.0	18.0	8	28	26	9	32.5
BAKKANCA	BRITISH	13	16.8 N	87.5 W	06	09	44	10 NM	02	1007.5	30.0	29.0	6	8	03	6	8
NORUM ELAN	NORWEGIAN	16	41.0 N	51.0 W	18	24	45	2 NM	15	990.0	12.0	16.0		23			
AMER LEGEND	AMERICAN	24	44.0 N	43.5 W	18	21	48	5 NM	02	1002.0	11.2	12.3	8	19.5	22	9	23
GREAT LAKES VESSELS																	
J A H IGLEHART	AMERICAN	6	43.7 N	87.6 W	00	30	M 35	1 NM	07		- 3.0	1.0	3	6.5			
CASUN J CALLAWAY	AMERICAN	12	45.9 N	84.1 W	18	12	M 44	5 NM	03		1.0	3.0	7	8			

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

Table 6

Selected Gale and Wave Observations, North Pacific

March and April 1979

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves? Period sec.	Sea Waves? Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		MAR.															
POLAR SEA	AMERICAN	1	59.9 N	172.4 E	21	02	M 42	1 NM	71	1006.3	- 4.5	0.0	6	13			
MOBIL MERIDIAN	AMERICAN	2	59.8 N	145.4 W	18	05	M 43	2 NM	72	980.7	- 1.7	3.4	8	8	14	9	10
VIOLET	LIBERIAN	2	34.2 N	144.8 E	06	34	M 42	10 NM	02	1007.0	9.0	19.0	6	6.5			
JOSEPH HEWES	AMERICAN	3	29.6 N	169.8 E	18	30	45	10 NM	02	1009.5	16.2	19.4	11	19.5	26	12	19.5
PRES MCKINLEY	AMERICAN	3	29.9 N	173.1 E	06	26	48	10 NM	01	1003.2	19.4	16.2	4	11.5	26	8	16.5
JOSEPH HEWES	AMERICAN	4	29.6 N	109.0 E	00	30	42	10 NM	02	1013.2	16.7	17.3	6	19.5	27	9	29.5
MOBIL MERIDIAN	AMERICAN	4	53.0 N	133.9 W	12	14	M 42	5 NM	02	983.1	7.3	6.2	4	6.5	14	10	8
LING YUNG	CHINESE	4	35.0 N	149.5 E	18	08	M 45	2 NM	05	997.0	10.0	12.0	9	19.5	10	>13	32.5
PRES MCKINLEY	AMERICAN	4	29.9 N	167.5 E	00	29	45	10 NM	01	1012.9	17.8	16.7	5	19.5	29	11	26
AUSTRAL MOON	AMERICAN	4	48.1 N	125.0 W	19	16	M 50	2 NM	05	1009.5	7.8	6.7	10	32.5			
JOSEPH HEWES	AMERICAN	5	29.8 N	160.0 E	12	24	56	2 NM	02	998.7	17.8	19.5					
PACIFIC ERA	LIBERIAN	5	29.6 N	158.5 E	12	25	47	5 NM	02	1001.0	17.0	20.0	7	16.5	25	>13	19.5
ORIENTAL EDUCATOR	BRITISH	5	27.7 N	164.0 E	21	27	M 45	5 NM	01	1004.2	21.0	22.0	5	5	29	10	14.5
TOKYO RAINBOW	JAPANESE	5	32.9 N	152.9 E	06	31	M 47	2 NM	04	987.4	15.0	17.0	5	8	14	8	19.5
PRES MCKINLEY	AMERICAN	5	30.9 N	156.2 E	09	27	60	1 NM	25	991.0	17.8	16.7	5	24.5	26	12	41
MARITIME UNITY	PANAMANIAN	5	32.9 N	144.6 E	00	34	M 60	2 NM	15	988.0	13.0	18.0	8	24.5			
LING YUNG	CHINESE	5	34.9 N	130.4 E	00	06	M 48	2 NM	05	985.0	12.0	14.0	12	49	07	>13	65.5
AUSTRAL MOON	AMERICAN	5	46.8 N	124.4 W	00	18	M 48	1 NM	03	1013.8	9.5	7.8	5	19.5			
JOSEPH HEWES	AMERICAN	6	29.8 N	158.8 E	00	35	42	10 NM	02	1013.1	16.7	18.9	5	19.5	31	10	29.5
LAUREL	LIBERIAN	6	41.1 N	136.5 W	06	18	M 47	1 NM	25	1008.0	14.0	8.0	8	14.5			
MAYA PIONEER	JAPANESE	6	29.5 N	175.4 E	00	23	M 60	.5 NM	21	1000.0	21.0	19.0					
ORIENTAL EDUCATOR	BRITISH	6	27.6 N	163.6 E	00	27	M 42	5 NM	02	1008.0	21.0	22.0	4	5	29	9	19.5
MONSING ARROW	PANAMANIAN	6	39.0 N	171.4 E	21	20	M 55	.25 NM	07	974.5	8.5	11.0	5	26			
VAN WARRIOR	LIBERIAN	7	40.2 N	150.3 E	12	32	45	10 NM	03	1010.5	1.0	8.0					
CRESSIDA	PANAMANIAN	7	33.8 N	154.2 W	12	17	M 45	2 NM	05	1009.0	18.5	19.7	7	26			
BEISMU MARU	JAPANESE	7	49.8 N	164.8 W	21	35	M 42	2 NM	02	987.0	1.5	7.0	5	13	01	8	16.5
PRES TAFT	AMERICAN	7	36.8 N	174.0 W	00	29	55	10 NM	03	997.0	10.0	11.7	5	11.5	33	>13	24.5
SEATRAIN CONCORD	FRENCH	7	36.7 N	149.7 W	12	15	M 42	5 NM	02	1010.5	15.7	19.0	6	13			
PACIFIC ERA	LIBERIAN	7	32.8 N	152.7 E	06	28	47	10 NM	30	1008.0	18.5	18.0	8	13	27	13	19.5
TOYUTA MARU # 10	JAPANESE	7	50.9 N	137.8 W	00	24	M 48	5 NM	02	1003.5	8.5	10.0	3	10	25	8	19.5
SEALAND FINANCE	AMERICAN	7	47.8 N	165.2 W	12	07	50	5 NM	02	985.0	2.2	3.3	6	14.5			
MONSING ARROW	PANAMANIAN	7	38.7 N	171.2 W	00	34	M 55	1 NM	07	981.0	9.5	12.0	5	24.5	14	6	26
LING YUNG	CHINESE	7	35.8 N	168.4 E	18	23	M 47	5 NM	21	1005.0	15.0	12.0	10	26	23	>13	49
FRIENDSHIP	LIBERIAN	7	37.4 N	171.4 E	18	21	M 55	1 NM	82	1003.0	12.0	13.0	8	16.5			
TOYUTA MARU # 10	JAPANESE	8	52.0 N	148.1 W	00	11	M 43	5 NM	02	1008.0	6.5	8.5	3	10	13	8	19.5
VIOLET	LIBERIAN	8	42.7 N	164.9 W	06	32	M 42	5 NM	02	1006.0	3.0	11.0	5	6.5	33	< 6	10
ARCO JUNEAU	AMERICAN	8	53.4 N	134.9 W	12	14	M 45	10 NM	02	1023.0	8.0	1.7	2	5	15	7	11.5
BEISMU MARU	JAPANESE	8	49.9 N	163.6 W	00	35	M 47	.5 NM	03	981.5	2.5	7.0	7	13	01	10	18
PRESIDENT MADISON	AMERICAN	8	54.3 N	103.7 W	06	35	50	1 NM	75	998.8	0.0	2.2	XX	19.5			
JELA TOPIC	LIBERIAN	8	44.7 N	166.8 E	06	27	50	.25 NM	72	975.0	- 1.0	- 1.0	8	19.5			
LING YUNG	CHINESE	8	34.8 N	170.2 E	00	28	M 30	5 NM	03	1013.5	17.0	13.0	7	26	27	6	32.5
EXXUN PHILADELPHIA	AMERICAN	8	59.7 N	145.6 W	18	11	45	1 NM	74	1007.2	2.7	6.0	10	19.5	11	12	24.5
FRIENDSHIP	LIBERIAN	8	37.2 N	169.3 E	00	27	M 42	5 NM	01	1005.0	11.5	17.0	10	14.5	29	11	24.5
CHEVRON WASHINGTON	AMERICAN	9	60.0 N	146.2 W	06	11	M 47	5 NM	03	1005.9	4.0		5	13	11	6	24.5
BEISMU MARU	JAPANESE	9	48.0 N	154.7 W	00	26	M 45	5 NM	02	994.4	5.0	8.0	8	14.5	28	11	19.5
PORTLAND	AMERICAN	9	59.0 N	151.4 W	00	08	68	.5 NM	74	996.3	2.2	2.8	8	13			
SEALAND FINANCE	AMERICAN	9	49.9 N	147.0 W	00	19	55	10 NM	02	997.0	7.2	3.3	6	19.5	19	11	24.5
PACIFIC ARROW	JAPANESE	9	37.9 N	179.5 W	12	28	M 35	10 NM	03	1011.5	9.5		8	26	31	>13	32.5
JELA TOPIC	LIBERIAN	9	45.6 N	171.3 E	00	27	50	.25 NM	70	984.0	2.0	2.0	8	23			
PRES TAFT	AMERICAN	10	36.9 N	140.4 W	00	31	45	10 NM	25	1016.2	12.8	12.8	5	10	33	13	23
PACIFIC ARROW	JAPANESE	10	38.1 N	174.4 W	00	26	M 28	5 NM	80	1013.0	11.5	12.5	7	19.5	31	>13	32.5
PRES TAYLOR	AMERICAN	11	41.5 N	148.9 E	18	32	60	1 NM	70	990.4	- 1.1	0.6	12	29.5			
LING YUNG	CHINESE	11	35.7 N	165.7 W	00	17	M 15	5 NM	02	1010.0	18.0	14.0	6	13	34	>13	32.5
NEW ENGLAND HUNTER	LIBERIAN	11	33.3 N	129.3 E	06	30	42	5 NM	02	1012.5	9.6	14.0	8	11.5			
MAYA PIONEER	JAPANESE	11	33.6 N	146.8 E	06	32	M 43	1 NM	11	999.1	14.0	15.0					
PRES TRUMAN	AMERICAN	11	33.8 N	137.5 W	06	32	45	5 NM	18	1017.3	14.5	15.5	5	16.5	32	< 6	23
PRESIDENT MADISON	AMERICAN	11	46.8 N	152.9 E	12	07	50	.5 NM	75	975.5	1.1	6.0	11	26			
GLADIOLUS	LIBERIAN	11	42.0 N	147.8 E	18	32	M 65	1 NM	20	997.0	0.0	2.0	8	14.5	32	9	21
VANGUARD	LIBERIAN	11	44.1 N	150.3 E	18	31	M 60	50 YD	88	973.0	0.0	1.0					
VAN ENTERPRISE	LIBERIAN	11	46.1 N	156.7 E	12	12	M 50	1 NM	22	977.0	2.5	3.0					
AMER CHAMPION	AMERICAN	11	33.6 N	137.4 E	00	01	50	2 NM	10	1004.5	10.0	18.8	6	11.5	04	8	14.5
ASIA BRAVERY	LIBERIAN	11	41.3 N	148.9 E	12	28	M 44	2 NM	02	986.5	1.0	3.0					
OVERSEAS NATALIE	AMERICAN	12	51.7 N	137.0 W	18	17	41	5 NM	30	1007.8	7.7	6.2	10	8	17	8	16.5
PRES TAYLOR	AMERICAN	12	40.6 N	148.5 E	06	29	60	10 NM	02	1005.4	2.2	2.2	15	49			
ORIENTAL SOVERIGN	LIBERIAN	12	32.7 N	170.7 E	12	14	M 50	2 NM	02	1000.0	1.0	6.0	3	8	14	6	21
PRESIDENT MADISON	AMERICAN	12	44.4 N	149.7 E	00	31	70	.5 NM	75	986.0	- 3.3	- 1.1	13	18			
PRES PIERCE	AMERICAN	12	41.2 N	162.2 E	06	24	45	10 NM	02	993.6	8.0	9.0	4	8	24	>13	18
SEATRAIN VALLEY FORGE	SINGAPORE	12	36.3 N	149.6 W	06	20	M 44	5 NM	80	1009.8	15.0	14.0					
POLAR ALASKA	LIBERIAN	12	42.3 N	154.4 E	00	27	M 45	2 NM	77	983.0	1.0	4.0					
GLADIOLUS	LIBERIAN	12	40.2 N	147.2 E	06	32	M 50	10 NM	01	1012.0	1.0	2.0	8	13	32	9	19.5
VANGUARD	LIBERIAN	12	43.3 N	150.9 E	00	31	M 60	50 YD	83	989.5	- 3.0	2.0			31	9	36
VAN ENTERPRISE	LIBERIAN	12	44.1 N	153.9 E	06	28	M 63	.5 NM	73	981.0	0.0	3.0					
ASIA BRAVERY	LIBERIAN	12	40.5 N	147.3 E	00	31	M 41	2 NM	02	1008.0	0.0	3.0	4	6.5	32	10	18
ALSTER EXPRESS	GERMAN	12	46.8 N	153.9 E	12	30	44	2 NM	70	976.0	- 2.0			11.5	30		19.5
CHEVRON ARIZONA	AMERICAN	12	57.0 N	148.3 W	18	06	M 45	10 NM	25	991.8	2.3		8	19.5	12	7	11.5
SANTA CLARA	AMERICAN	13	58.5 N	150.4 W	00	09	45	2 NM	03	987.8	2.2	4.4	6	13	09	8	16.5
SEALAND TRADE	AMERICAN	13	50.8 N	148.2 W	00	20	47	10 NM	02	977.0	4.4	4.4	8	10	21	9	13
ARCTIC TOKYO	LIBERIAN	13	53.4 N	134.6 W	12	16	M 47	1 NM	03	1002.0	2.0	2.0	5	10			
ALSTER EXPRESS	GERMAN	13	44.4 N	151.9 E	00	30	44	2 NM	85	1002.5	- 0.9			13	30		19.5
ATLANTIC PIONEER	PANAMANIAN	13	34.4 N	156.0 W	18	23	M 43	5 NM	02	991.5	3.0	3.0	9	23	33	6	23
OVERSEAS NATALIE	AMERICAN	13	50.5 N	135.7 W	00	16	43	5 NM	01	1011.3	8.9	6.7	6	10	16	8	16.5
MOBIL ARCTIC	AMERICAN	13	59.3 N	144.5 W	00	09	M 60	1 NM	07	997.6	3.5	3.8			09	< 6	10
GREAT LAND	AMERICAN	13	58.7 N	150.4 W	00	05	M 46	1 NM	31	991.0	2.0	3.6			03	8	13
MOBIL MERIDIAN	AMERICAN	14	53.4 N	134.6 W	12	16	M 45	10 NM	15	993.6	7.7	8.5	5	8	23	12	8
PRES ROOSEVELT	AMERICAN	14	40.0 N	170.4 E	21	35	55	1 NM	05	992.8	5.6	13.9	6	19.5	31	8	21
UNIVERSE KURE	LIBERIAN	15	29.9 N	153.3 E	18	22	M 42	5 NM	80	998.3	18.0	19.4	5	11.5			
PRES ROOSEVELT	AMERICAN	15	41.6 N	179.2 E	18	29	50	5 NM	07	1000.5	5.0	9.4	11	41			
SOUTHELL	AMERICAN	16	36.8 N	170.9 W	12	06	M 43	2 NM	02	989.1	- 0.5	3.3					
ATLANTIC PIONEER	PANAMANIAN	16	30.9 N	179.5 W	12	32	M 42	5 NM	05	984.0	4.0	4.0					

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves*			Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.	Height ft.
NORTH PACIFIC OCEAN		MAR.																
LIONS GATE BRIDGE	JAPANESE	16	54.1 N	173.8 W	06	07	M 43	2 NM	02	979.0	3.7	3.0	6	10	09	9	13
GOLDEN DAISY	LIBERIAN	16	42.5 N	177.5 E	18	14	M 43	5 NM	61	983.0	10.0	5.0					
CRESSIDA	PANAMANIAN	16	31.0 N	155.5 E	00	28	M 43	.25 NM	05	1004.0	20.0	19.2	7	19.5			
ORIENTAL COMMANDER	LIBERIAN	16	37.0 N	171.7 E	06	16	34	5 NM	51	1000.1	12.0				10		32.5
PRES ROOSEVELT	AMERICAN	16	42.0 N	178.2 W	00	28	48	5 NM	16	1006.2	6.7	10.6	11	36			
SEATRAIN VALLEY FORGE	SINGAPORE	16	33.9 N	174.2 E	18	28	M 42	10 NM	81	998.6	14.8	13.0	4	6.5	29	10	10
BELLMAN	SINGAPORE	17	33.8 N	177.0 W	00	20	M 46	2 NM	02	1005.0	19.0	16.0	5	6.5	17	8	11.5
ARCO JUNEAU	AMERICAN	17	35.3 N	197.5 W	12	15	M 50	10 NM	02	995.0	19.0	16.0	5	6.5			
ATLANTIC PIONEER	PANAMANIAN	17	48.9 N	170.3 E	18	33	M 43	1 NM	40	981.5	1.0	2.0	4	6.5			
CRESSIDA	PANAMANIAN	17	32.3 N	146.9 E	18	18	M 44	30 YD	39	1005.0	18.5	14.2	7	26	18	7	29.5
NEWARK	AMERICAN	17	34.7 N	138.7 W	18	16	35	5 NM	02	987.8	4.4	3.0	5	19.5	16	9	32.5
HONSHU GLORIA	LIBERIAN	17	50.8 N	162.8 W	06	26	M 42	10 NM	02	996.0	9.5	9.5	4	24.5	24	6	29.5
PRES ROOSEVELT	AMERICAN	17	42.2 N	159.3 W	18	18	35	2 NM	02	1012.2	11.2	10.0	4	19.5	28	10	32.5
SEATRAIN VALLEY FORGE	SINGAPORE	17	33.6 N	171.8 E	06	28	M 45	10 NM	02	1012.6	13.0	14.0	6	13	30	10	19.5
PRES ROOSEVELT	AMERICAN	18	42.0 N	156.0 W	00	20	45	5 NM	02	1014.8	12.2	10.6	4	19.5	28	10	32.5
QUEENS WAY BRIDGE	JAPANESE	18	36.6 N	157.0 W	18	18	M 43	2 NM	02	1015.0	15.0	14.0	5	11.5			
SEATRAIN VALLEY FORGE	SINGAPORE	18	33.4 N	163.2 E	18	21	M 37	5 NM	80	1003.5	15.0	16.0	5	10			
GARDENIA	LIBERIAN	18	36.3 N	147.1 E	00	10	M 45	2 NM	10	1006.0	10.5	17.0	10	19.5	29	9	23
BELLMAN	SINGAPORE	18	33.9 N	179.1 E	00	28	M 42	2 NM	02	1009.0	11.0	16.0	5	8	28	10	16.5
ATLANTIC PIONEER	PANAMANIAN	18	48.4 N	168.7 E	00	33	M 45	10 NM	03	999.0	1.0	3.0	9	11.5	33	13	16.5
VAN CONQUEROR	LIBERIAN	18	41.9 N	152.0 E	18	29	M 49	1 NM	72	1002.0	- 2.0	6.0					
GOLDENROD	LIBERIAN	18	42.1 N	152.4 E	18	30	M 48	200 YD	72	1000.5	- 1.0	6.0					
EASTERN VENTURE	JAPANESE	18	42.7 N	149.5 E	12	29	M 36	1 NM	10	1003.0	- 2.5	1.0			28	6	23
FRIENDSHIP	LIBERIAN	18	38.3 N	162.0 E	06	20	M 41	5 NM	03	1007.0	11.0	13.0	8	10	22	9	11.5
ASIA BEAUTY	LIBERIAN	19	42.9 N	172.9 E	00	27	M 45	5 NM	01	987.5	6.0	4.0	XX	23			
SEATRAIN VALLEY FORGE	SINGAPORE	19	33.6 N	158.0 E	12	31	M 44	5 NM	81	1017.0	11.0	16.0					
SEALAND COMMERCE	AMERICAN	19	43.3 N	164.5 E	00	27	47	10 NM	01	986.6	3.5	3.5	5	8	27	>13	24.5
VAN CONQUEROR	LIBERIAN	19	41.6 N	151.4 E	00	29	M 32	2 NM	70	1010.0	- 1.0	3.0					
PRES FILLMORE	AMERICAN	19	37.5 N	177.3 E	00	22	36	10 NM	03	1005.1	12.2	13.9	4	11.5	23	7	36
EASTERN VENTURE	JAPANESE	19	42.3 N	147.9 E	00	31	M 43	5 NM	05	1018.0	- 2.0	1.0			32	9	19.5
GOLDENROD	LIBERIAN	19	41.9 N	151.8 E	00	30	M 39	200 YD	72	1005.0	0.0	6.0	13	44	30	>13	49
GARDENIA	LIBERIAN	19	38.4 N	159.1 E	18	31	M 51	2 NM	02	1017.0	8.0	14.0	14	46	31	9	52.5
LAUREL	LIBERIAN	20	34.0 N	178.0 E	06	27	M 43	10 NM	02	1006.0	16.0	14.0	7	14.5			
BELLMAN	SINGAPORE	20	33.6 N	171.5 E	06	29	M 48	5 NM	81	1010.0	12.0	13.0	6	11.5	29	>13	23
GARDENIA	LIBERIAN	20	34.9 N	160.9 E	00	31	M 51	5 NM	02	1021.5	12.0	14.0	14	46	31	9	52.5
ROSE	LIBERIAN	21	31.9 N	197.5 E	12	04	M 42	5 NM	25	1010.5	12.5	20.0					
HONSHU GLORIA	LIBERIAN	21	48.2 N	171.1 E	00	32	M 42	> 25 NM	03	994.8	4.6	4.0	5	14.5	30	12	23
PRES JEFFERSON	AMERICAN	21	48.9 N	158.0 W	00	16	45	5 NM	03	1009.4	7.8	9.3	8	19.5	13	9	23
LAUREL	LIBERIAN	22	34.4 N	197.0 E	06	22	M 42	2 NM	25	1002.0	17.0	13.0	8	14.5			
AMER AQUARIUS	AMERICAN	22	37.1 N	171.7 E	12	18	50	5 NM	51	977.0	12.8	14.0	5	13			
PRESIDENT MADISON	AMERICAN	23	41.0 N	156.0 E	18	29	45	10 NM	85	1018.0	- 0.7	6.7					
GARDENIA	LIBERIAN	23	37.9 N	178.0 W	00	18	M 48	.25 NM	47	1007.5	13.0	12.0	12	31	18	9	36
LAUREL	LIBERIAN	23	34.8 N	147.4 E	00	18	M 44	2 NM	60	1000.0	16.0	14.0	7	14.5			
GRAND CARRIER	LIBERIAN	23	40.1 N	145.0 E	12	25	M 44	2 NM	18	999.0	4.0	6.0					
HONSHU GLORIA	LIBERIAN	23	39.8 N	146.4 E	18	30	M 36	10 NM	02	1000.4	7.5	11.5					
EASTERN DIAMOND	PANAMANIAN	25	38.1 N	140.0 E	12	16	30	.5 NM	30	1010.0	11.0	11.0	3	5			
VANGUARD	LIBERIAN	25	38.8 N	146.4 E	18	27	M 48	2 NM	03	1003.0	8.0	13.0					
SEALAND FINANCE	AMERICAN	25	38.3 N	144.1 E	06	28	50	10 NM	02	996.3	9.4	2.8	5	14.5	27	7	16.5
VANGUARD	LIBERIAN	26	38.8 N	148.2 E	00	29	M 43	5 NM	02	1007.0	11.5	11.0			29	10	24.5
PACIFIC WING	PANAMANIAN	27	38.2 N	125.6 W	12	18	M 46	1 NM	04	984.0	12.0	12.0	4	19.5	XX	9	19.5
PRINCE WILLIAM SOUND	AMERICAN	29	36.7 N	123.6 W	00	36	M 45	5 NM	02	999.0	12.8	13.4	7	11.5	31	8	18
CRESSIDA	PANAMANIAN	31	36.2 N	145.4 E	18	29	M 42	5 NM	01	1011.5	11.0	12.0	10	26	29	9	32.5
EASTERN RIVER	LIBERIAN	31	36.6 N	153.4 E	18	27	M 70	.5 NM	07	1001.6	13.0						
PRES KENNEDY	AMERICAN	31	44.3 N	153.7 E	06	11	45	2 NM	10	970.0	1.6	0.6	8	26			
POLAR ALASKA	LIBERIAN	31	46.1 N	155.5 E	12	07	M 45	.25 NM	97	976.0	0.0	0.0	5	11.5			
MIDAS RHEIN	LIBERIAN	31	40.3 N	165.4 E	12	18	M 46	2 NM	58	993.5	11.0	10.0	6	19.5	18	6	14.5
ADRIAN MAERSK	DANISH	31	47.0 N	154.2 E	18	07	50	2 NM	71	982.0	0.0						
AMER LEGION	AMERICAN	31	36.6 N	147.5 E	00	23	60	1 NM	07	987.8	18.9	10.7	10	29.5			
VIOLET	LIBERIAN	31	32.9 N	151.1 E	00	21	M 42	2 NM	15	1007.0	19.0	20.0	12	16.5	21	12	18
SEALAND EXCHANGE	AMERICAN	31	44.8 N	152.8 E	06	09	47	200 YD	75	972.6	- 1.2	- 0.6	10	16.5			
ENVIRONMENTAL BUOYS																	
46001	AMERICAN	8	56.0 N	148.0 W	06	09	M 41			1003.4	2.7	3.6	6	13			
46004	AMERICAN	4	51.0 N	136.0 W	21	21	M 42			984.3	6.6	6.3	8	14.5			
NORTH PACIFIC OCEAN		APR.															
EASTERN RIVER	LIBERIAN	1	36.3 N	151.9 E	00	27	M 34	5 NM	30	1007.6	9.0	14.0	5	29.5	27	9	29.5
CRESSIDA	PANAMANIAN	1	36.3 N	147.2 E	00	30	M 42	5 NM	01	1012.0	12.0	14.4	10	26	30	9	29.5
PRES KENNEDY	AMERICAN	1	42.8 N	148.9 E	00	32	44	1 NM	70	998.9	3.3	0.6	5	13	32	9	24.5
MOBIL ARCTIC	AMERICAN	1	40.0 N	125.5 W	18	34	M 43	10 NM	02	1028.0	10.0	10.0	6	6.5			
POLAR ALASKA	LIBERIAN	1	47.1 N	158.4 E	00	07	M 45	1 NM	94	980.0	0.0	0.0	6	13			
MIDAS RHEIN	LIBERIAN	1	39.3 N	165.4 E	12	24	M 30	1 NM	58	980.5	11.0	10.0	4	24.5	26	9	19.5
SEALAND EXCHANGE	AMERICAN	1	40.8 N	150.0 E	00	29	50	1 NM	07	995.3	1.1	2.2	8	11.5	29	12	19.5
ZEMLIN GLORY	LIBERIAN	1	40.5 N	177.3 E	12	17	M 42	.25 NM	11	996.5	14.0	16.0	7	26	18	9	39
SEALAND LEADER	AMERICAN	1	41.2 N	152.3 E	06	32	M 49	2 NM	26	998.8	3.6	2.0	6	10	33	9	32.5
SEALAND TRADE	AMERICAN	1	36.0 N	192.3 E	06	30	50	5 NM	03	1007.8	10.6	16.2	10	16.5	30	10	19.5
ADRIAN MAERSK	DANISH	1	45.9 N	191.9 E	00	36	50	2 NM	02	993.0	2.0		14	32.5			
MIDAS RHEIN	LIBERIAN	2	39.5 N	164.2 E	00	29	M 60	5 NM	03	996.0	8.3	8.0	4	24.5	29	9	18
SEALAND TRADE	AMERICAN	2	38.1 N	162.5 E	00	32	45	10 NM	02	1002.8	6.7	12.2	7	18	32	11	23
ARCO DUKE	BRITISH	2	34.1 N	168.1 E	00	28	44	10 NM	02	1005.9	12.8	15.6	5	29.5	32	7	11.5
MIDAS RHEIN	LIBERIAN	4	38.5 N	151.5 E	06	28	M 49	5 NM	02	1011.0	12.5	9.0	6	14.5			
CRESSIDA	PANAMANIAN	5	47.2 N	176.1 E	06	28	M 60	200 YD	51	982.0	2.0	2.1	10	26			
ALEUTIAN DEVELOPER	AMERICAN	6	58.6 N	150.5 E	18	09	M 48	2 NM	51	987.5	2.2	2.8	5	11.5	09	8	18
FRIENDSHIP	LIBERIAN	6	52.3 N	177.9 W	18	32	M 42	5 NM	02	986.0	2.5	4.0	5	14.5	32	11	18
PACIFIC VENTURE	PANAMANIAN	6	54.1 N	154.1 W	06	13	M 47	2 NM	50	987.6	4.0	5.0	12	23			
PRES TRUMAN	AMERICAN	6	32.4 N	147.1 E	00	07	45	5 NM	10	1014.6	14.5	16.8	5	16.5	07	< 6	19.5
ROBERTS BANK	LIBERIAN	6	53.2 N	156.2 W	06	18	45	5 NM	07	981.0	4.3	4.3	3	13	14	7	19.5
SEALAND PIONEER	AMERICAN	7	34.3 N	166.9 E	06	28	M 44	10 NM	03	1008.5	18.0	16.0	8	10	19	8	8
ALVA MAERSK	DANISH	7	38.0 N	185.9 E	06	32	48	1 NM	07	1003.0	10.8	13.0	9	41			
ARCO FAIRBANKS	AMERICAN	7	39.7 N	145.5 W	06	10	M 42	2 NM	02	987.9	1.6	6.7	7	10			
GLADIOLUS	LIBERIAN	7	30.5 N	140.5 W	00	19	M 48	1 NM	81	998.0	10.0	7.0	6	13			
HANGJIN	KOREAN	7	54.0 N	171.5 W	17	01	M 41	5 NM	30	1003.2	1.4	4.0	3	10	33	< 6	16.5
PACIFIC VENTURE	PANAMANIAN	7	53.5 N	170.8 W	18	34	M 42	10 NM	03	994.0	3.0	5.0	14	24.5			
ROBERTS BANK	LIBERIAN	8	52.5 N	158.6 W	00	30	45	10 NM	02	1000.5	4.0	4.0	4	8	30	7	19.5
AMERICA SUN	AMERICAN	9	44.6 N	130.2 W	12	20	M 42	10 NM	02	1016.6	13.0	8.0	8	8			
HONSING ARROW	PANAMANIAN	9	48.1 N	152.4 E	06	18	M 45	2 NM	81	992.0	4.5	1.0	5	10	18	< 6	26
ROBERTS BANK	LIBERIAN	10	49.0 N	171.0 E	12	18	M 49	2 NM	25	1007.0	2.4	1.0	6	10	18	10	10
ARCO PRUDHOE BAY	AMERICAN	10	39.8 N	121.8 W	06	32	42	5 NM	05	1016.1	14.0	10.7			31		14.5
HANGJIN	KOREAN	10	49.9 N	167.8 E	23	24	M 38	1 NM	90	997.0	2.3	3.0	8	14.5	24	11	32.5
HANGJIN	KOREAN	11	49.1 N	165.1 E	11	24	M 40	.5 NM	68	1002.0	1.5	2.0	8	16.5	24	11	30
PRES TRUMAN	AMERICAN	11	38.3 N	160.0 W	12	01	43	5 NM	02	1007.2	9.8	11.7	5	13	02	>13	18
SUNNY PIONEER	PANAMANIAN	12	50.7 N	134.0 W	12	09	M 49	1 NM	81	984.5	4.5	5.0	7	10			
SEA FAN	SINGAPORE	12	51.5 N	175.6 W	03	32	M 42	2 NM	03	1016.0	7.6	4.1	7	16.5	27	7	16.5

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind			Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves+		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°		Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.	Height ft.
NORTH PACIFIC OCEAN		APR.																
ARCO JUNEAU	AMERICAN	12	48.5 N	130.3 W	18	25	M	44	5 NM	60	989.5	10.6	5.0	5	32.5			
ALASKA STANDARD	AMERICAN	12	51.7 N	130.3 W	18	11		30	2 NM	63	980.8	7.2	9.6	4	13	13	8	13
EXXUN BATON ROUGE	AMERICAN	12	46.7 N	130.8 W	18	26	M	47	5 NM	07	989.0	9.0	7.7	1	5	22	10	16.5
OVERSEAS JUNEAU	AMERICAN	12	46.7 N	129.1 W	18	23		42	5 NM	03	990.0	11.1	8.9	5	16.5	28	8	16.5
OVERSEAS JUNEAU	AMERICAN	13	47.6 N	129.9 W	00	27		60	5 NM	50	989.8	8.9	8.9	5	16.5	28	9	23
ORIENTAL LEADER	LIBERIAN	13	33.9 N	151.6 E	02	33	M	60	< 50 YD	99	1012.5	11.0	17.0	6	18			
MOBIL ARCTIC	AMERICAN	13	50.2 N	131.0 W	18	29	M	45	10 NM	02	1008.5	8.5	6.7		6.5			
JOSEPH HEWES	AMERICAN	13	07.0 N	134.8 E	00	24		36	200 YD		1002.0	23.4	23.3	5	19.5			
EXXUN BATON ROUGE	AMERICAN	13	46.4 N	129.3 W	00	26	M	35	5 NM	18	998.0	10.0	8.3	2	8	26	9	49
ROBERTS BANK	LIBERIAN	13	42.7 N	133.5 E	12	33		47	5 NM	02	1006.0	0.5	2.0	5	8	10	8	24.5
SEATRAIN VALLEY FORGE	SINGAPORE	13	35.8 N	141.4 W	00	03	M	41	1 NM	10	1017.7	12.5	14.0	10	13			
ARCO JUNEAU	AMERICAN	13	46.4 N	130.3 W	00	27	M	51	5 NM	60	999.1	9.4	5.5	5	8	26	< 6	41
PRES JOHNSON	AMERICAN	14	48.8 N	139.4 E	18	34		45	5 NM	02	998.9	2.2	0.6	3	8	32	12	14.5
EASTERN DIAMOND	PANAMANIAN	16	52.7 N	178.6 W	14	24	M	43	5 NM	03	999.5	7.0	0.5	10	11.5			
VAN ENTERPRISE	LIBERIAN	18	42.0 N	138.5 E	12	26	M	46	5 NM	02	996.0	5.0	7.0					
GARDENIA	LIBERIAN	19	52.5 N	168.6 W	18	20	M	44	1 NM	10	1013.0	5.0	5.0	10	36			
VAN ENTERPRISE	LIBERIAN	19	42.9 N	144.4 E	06	26	M	45	5 NM	03	1000.0	3.0	6.0					
GARDENIA	LIBERIAN	20	52.2 N	170.3 W	00	19	M	42	.25 NM	45	1009.5	7.0	5.0	10	36			
GRAND CARRIER	LIBERIAN	21	36.4 N	137.2 E	18	27	M	41	5 NM	03	1000.0	14.0	13.5					
PRESIDENT MADISON	AMERICAN	22	47.6 N	176.1 E	23	25		33	5 NM	10	987.5	5.6	1.1	11	24.5	20	10	24.5
ADRIAN MAERSK	DANISH	22	43.1 N	165.1 E	06	32		45	2 NM	02	982.3	3.0		7	16.5	18	10	19.5
GARDENIA	LIBERIAN	22	51.0 N	147.5 E	18	35	M	42	.25 NM	69	995.0	1.0	2.0	9	29.5	35	11	31
EASTERN DIAMOND	PANAMANIAN	22	40.6 N	139.3 E	17	21	M	46	2 NM	02	1019.0	12.0	10.0	10	6.5			
GRAND CARRIER	LIBERIAN	22	37.1 N	141.1 E	06	21	M	41	10 NM	03	1006.0	15.0	12.0					
SAMOA	DANISH	22	46.0 N	178.4 W	18	18		47	1 NM	30	1001.4	8.2	5.0	9	21			
NORTH STAR III	AMERICAN	23	53.3 N	168.7 W	12	18	M	35	1 NM	65	1003.2	4.4	5.0	7	14.5			
EASTERN DIAMOND	PANAMANIAN	23	38.9 N	136.6 E	05	21	M	45	5 NM	02	1017.2	12.0	8.0	10	8			
KOREAN FIR	LIBERIAN	23	53.2 N	170.8 E	00	01	M	45	.25 NM	34	997.0	3.0	4.0	7	13	01	11	8
SAMOA	DANISH	23	46.4 N	176.3 W	00	20		45	2 NM	10	1006.0	9.6	5.0			14	10	13
NORTH STAR III	AMERICAN	24	53.1 N	169.8 W	00	22	M	42	2 NM	64	1006.4	3.9	5.0	8	8	24	>13	14.5
BELLMAN	SINGAPORE	25	39.5 N	135.7 W	18	05	M	41	5 NM	03	1009.7	12.5	12.0	3	3	08	< 6	6.5
PRES JEFFERSON	AMERICAN	26	54.0 N	167.5 W	18	18		47	2 NM	61	1001.0	7.2	9.3	6	8	18	9	24.5
NORTH STAR III	AMERICAN	26	52.2 N	168.9 W	18	20	M	35	2 NM	62	1002.4	5.5	5.0	8	18			
CRESSIDA	PANAMANIAN	26	54.1 N	172.5 W	18	20	M	48	1 NM	05	998.0	4.0	0.6	6	19.5	19	7	23
MONOMU GLORIA	LIBERIAN	26	51.9 N	173.1 W	18	23	M	33	10 NM	03	1000.0	5.0	6.0	4	24.5	20	6	26
NORTH STAR III	AMERICAN	27	53.6 N	167.8 W	18	16	M	44	2 NM	63	997.3	5.8	5.0	4	10			
PRES JEFFERSON	AMERICAN	27	54.1 N	169.6 W	00	22		45	5 NM	01	1001.8	7.2	3.3	8	29.5			
SEALAND TRADE	AMERICAN	27	54.1 N	168.2 W	00	21		45	2 NM	10	1003.0	5.0	3.3	5	5	23	10	19.5
ARCTIC TOKYO	LIBERIAN	27	38.0 N	142.2 E	12	04	M	43	5 NM	02	1009.0	11.5	19.0	4	10			
PRES TRUMAN	AMERICAN	28	36.8 N	139.2 E	12	23		45	10 NM	03	1004.7	16.8	12.3	5	13	23	< 6	16.5
ALVA MAERSK	DANISH	28	36.7 N	155.1 E	06	29		43	2 NM	05	1005.2	13.3	13.0	8	19.5			
LING YUNG	CHINESE	29	42.3 N	175.8 W	00	15	M	45	5 NM	03	1003.0	10.0	8.0	7	10	14	10	32.5
ALEUTIAN DEVELOPER	AMERICAN	30	55.2 N	160.3 W	18	07	M	48	5 NM	31	991.5	3.9	2.8	4	8.5	07	7	14.5
LAUREL	LIBERIAN	30	35.2 N	148.4 E	06	17	M	44	5 NM	03	1013.0	19.0	15.0	6	10			
PRES JEFFERSON	AMERICAN	30	41.0 N	148.1 E	18	25		43	2 NM	01	993.6	7.8	0.0	4	8.5	24	7	14.5
ENVIRONMENTAL BUOYS																		
46004	AMERICAN	12	51.0 N	136.0 W	12	07	M	47			985.6	3.6	6.4	8	14.5			
46005	AMERICAN	12	46.0 N	131.0 W	17	23	N	51			994.4	8.6	9.1					
46005	AMERICAN	13	46.0 N	131.0 W	00	27	M	44			1003.6	8.6	9.0	11	26			

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

Table 7
U.S. Cooperative Ship Weather Reports
March and April 1979

This listing includes only those ships recruited in the U.S. Cooperative Ship Program whose Ship's Weather Observations (NOAA Form 72-1) were mailed to the National Climatic Center and/or the coded weather observations were transmitted to the appropriate radio station.

TOTAL WEATHER REPORTS RECEIVED FROM US COOPERATIVE OBSERVING SHIPS MARCH AND APRIL 1979

SHIP NAME	VIA RADIO	VIA MAIL
OGDEN THAMES	65	
ADM WM M CALLAGHAN	25	33
AFRICAN MERCURY	13	
AGUADILLA	87	140
ALBATROSS IV	14	
ALEX STEPHENS	10	34
ALPHA HELIX	21	87
AMERICA MARU	82	35
AMERICAN ALLIANCE	47	84
AMERICAN ARGOSY	35	98
AMERICAN CHAMPION	78	94
AMERICAN COURIER	28	83
AMERICAN LARK	37	143
AMERICAN LEGION	29	117
AMERICAN RANGER	12	77
AMOCO MILFORD HAVEN	32	38
ANCO STANE	35	
ANNA MAERSK	17	48
AQUILA	10	23
ARCO HERITAGE	4	39
ARCO SAG RIVER	7	145
ARNOLD MAERSK	29	77
ASHLEY LYKES	8	
ASIA FLAMINGO	6	
ASIA MORALITY	9	111
ATLANTIC HIGHWAY	11	
AUSTRAL ENTENTE	20	73
AUSTRAL PATRIOT	1	67
AXEL MAERSK	29	80
BALTIMORE	1	
BASSWOOD WLB388	16	
BEISHU MARU	99	44
BLUE OCEAN	18	102
BONITA	1	
BRAZOS	34	134
BUNGA SRIPAGI	10	
CALIFORNIA RAINBOW	14	26
CARBIDE SEADRIFT	24	130
CEDRELA	8	51
CHARLES LYKES	20	81
CHASTINE MAERSK	6	16
CHERISH	3	27
CHEVRON ANTWERP	19	213
CHEVRON CALIFORNIA	30	118
CHEVRON FELUY	18	136
CHEVRON MISSISSIPPI	30	94
CHEVRON PERNIS	24	124
CHRISTOPHER LYKES	11	95
COLORADO	35	74
COLUMBUS AUSTRALIA	30	58
COLUMBUS WELLINGTON	20	70
CORAL ACE	17	
COSMOS GIENAH	34	112
CRESSIDA	31	141
DAIOH MARU	2	100
DAVID D. IRWIN	7	29
DAVIDSON	1	
DEL SOL	20	57
DELTA AFRICA	7	46
DELTA CARIBE	18	35
DELTA MEXICO	23	4
DEPENDABLE WMEC 626	3	
DITTE SKOU	8	41
DONA CORAZON II		32
DURABLE	37	
EASTERN JADE	18	
EASTERN VENTURE		111
EIDANGER		6
ELIZABETH LYKES	29	
ESSO BAYONNE	2	
EUROFREIGHTER	29	
EVER VICTORY	15	11
EXPORT AMBASSADOR	19	68
EXPORT BUYER	11	87
EXPORT COURIER	15	49
EXXON BALTIMORE	10	46
EXXON GETTYSBURG	8	37
EXXON LEXINGTON	7	
EXXON SAN FRANCISCO	28	80
FAIRWEATHER	16	29
FESTIVALE	24	49
FREDERICK LYKES	2	
GALLEON JADE	7	
GEMINI	12	44
GEORGE B KELEZ	3	
GIBRALTAR PANSY	5	10
GLOBAL FRONTIER	39	74
GOLDEN BEAR	8	49
GOLDEN GATE BRIDGE	111	94
GRACE	1	
GREAT REPUBLIC	39	53
GREEN PORT	2	42
GULF FARMER	18	38
GUTENFELS	5	
HAWAIIAN CITIZEN	30	91
HESS VOYAGER	91	113
HOEGH HALLARD	32	45
HOEGH MERIT	29	113
HOMSING ARROW	5	39
HOTAKA MARU	88	36
HOMSING ARROW	3	39
HUDSON T-AO 184	45	114
IRIS ISLAND	28	
ITAPUCA	2	
J T WIGGINS		148
JALAYAMUNA	9	
JAPAN ACE	113	98
JARVIS WMEC 725	72	
JELA TOPIC	32	44
JOHN TYLER	20	33
JUTHLANDIA	15	4
KEIYO	22	128
KOFUKU MARU		94
KOREAN COMMANDER	5	20
KRPAN	55	
LAKE BERRYESSA	11	
LASH ATLANTICO	2	84
LEO	14	28
LIONS GATE BRIDGE	32	41
LOUISE	72	111
MAGDALENA	26	
ACADIA FOREST	19	
ADRIAN MAERSK	30	81
AFRICAN METEOR	17	99
AIMEE LYKES	21	19
ALBERT MAERSK	20	70
ALLISON LYKES	9	57
ALPHAGAS	1	
AMERICA SUN	1	89
AMERICAN APOLLO	19	136
AMERICAN ARROW	13	10
AMERICAN CHARGER	23	119
AMERICAN EXPLORER	22	
AMERICAN LEADER	47	87
AMERICAN LIBERTY	23	
AMERICAN RELIANCE	16	61
AMOCO TRINIDAD	11	
ANCO TEMPLAR	39	
ANNIE JOHNSON		49
ARCO ANCHORAGE	8	97
ARCO JUNEAU	15	108
ARCTIC TOKYO	35	103
ARTHUR MAERSK	18	73
ASIA BEAUTY	44	108
ASIA HERON	9	9
ASIA ZEBRA	22	
ATLANTIC PIONEER	19	92
AUSTRAL ENVOY	32	104
AUSTRAL PILGRIM	10	
AZTECA	1	
BALTIMORE TRADER	16	34
BAUGNES	3	
BERGLJOT	33	59
BLUEBIRD	117	78
BORINQUEN	52	125
BREMSTER	31	89
C V LIGHTNING	8	49
CALIFORNIAN	43	73
CARIBIA	16	
CHALLENGER		137
CHARLES PIGOTT	12	149
CHAUVENET T AGS 29	9	94
CHERRY VALLEY	28	
CHEVRON ARIZONA	28	38
CHEVRON COLORADO	20	49
CHEVRON HAWAII	14	67
CHEVRON NAGASAKI		47
CHEVRON PERTH	22	134
CITY OF DUNDEE	2	
COLUMBIA	33	
COLUMBUS LOUISIANA	3	
COMEY	44	70
CORAL ARCADIA	8	
COURAGEOUS WMEC 622		8
CRISTOBAL	1	65
DALLAS WMEC 716	1	
DAVID P REYNOLDS	72	106
DEFIANCE	7	67
DELAWARE GETTY	21	97
DELTA AMERICA	13	20
DELTA COLUMBIA	1	15
DELTA PANAMA	4	28
DILIGENCE WMEC 616	2	120
DOCTOR LYKES	51	142
DONIC	13	31
DYVI KATTEGAT	29	41
EASTERN MUSE	47	
EASTERN WISEMAN	7	
EL PASO ARZEW		133
ENNA G	41	89
ESSO CASTELLON	13	
EVER SPRING	1	88
EXPOMO	1	
EXPORT BANNER	35	47
EXPORT CHALLENGER	24	98
EXPORT FREEDOM	24	46
EXXON BATON ROUGE	34	58
EXXON HOUSTON	33	87
EXXON NEW ORLEANS	13	32
EXXON SEATTLE	1	
FALSTRIA	19	111
FLEETBANK	24	
FRIENDSHIP	30	134
GALLEON PEARL	7	44
GENE TREFETHEN	116	
GEORGE M KELLER		186
GLACIER WAGB 4	112	119
GLOMAR CHALLENGER	91	177
GOLDEN DAISY	29	52
GOLDEN MISTRAL	12	
GRAND CARRIER	30	109
GREEN AUKLET	17	
GREEN SPRINGS	8	46
GULF FINN	1	
HARDANGER	10	
HELIOS	48	43
HILL MARU	75	54
HOEGH MARLIN	10	105
HOEGH OPAL	2	
HOLYLIGHT	1	
HOUSTON	24	101
HOLYLIGHT	1	
IMACHUS STAR	42	142
IRIS QUEEN	96	
J E GOSLINE	3	35
JACKSONVILLE	8	68
JAMAICA MARU	39	57
JAPAN AMBASSADOR	2	7
JAVARA		23
JOHN A. MCCONE	4	148
JOSEPH HEWES	17	98
K H CRANDALL	1	18
KRYSTONER	23	39
KOPAL	63	140
KOREAN PIR	6	31
KUROBE MARU	56	34
LAKE PALOURDE	4	201
LASH ITALIA		74
LESLIE LYKES	1	
LIPSCOMB LYKES	21	68
LOUISE LYKES	21	81
MAINE	34	99
ACUSHNET WAGO 167		59
AFRICAN COMET	16	62
AFRICAN NEPTUNE	12	88
ALASKA STANDARD	29	11
ALERT	1	
ALLTRANS EXPRESS	46	100
ALSTER EXPRESS	10	70
AMERICAN ACCORD	21	61
AMERICAN AQUARIUS	12	105
AMERICAN ASTRONAUT	22	122
AMERICAN CHIEFTAIN	6	
AMERICAN INDEPENDENCE	59	75
AMERICAN LEGACY	43	19
AMERICAN TRADER	11	137
ANCHORAGE	37	81
ANDERS MAERSK	3	43
ANTE TOPIC	25	73
ARCO ENTERPRISE		49
ARCO PRESTIGE	12	92
ARECIBO	1	13
ARTHUR MIDDLETON	73	117
ASIA BOTAN	12	91
ASIA HONESTY	21	11
ASIAN ASSURANCE	31	143
AUSTRAL ENDURANCE		32
AUSTRAL LIGHTNING	40	116
AUSTRAL PILOT	55	119
B T SAN DIEGO	9	27
BARRANCA	9	86
BAYANON	47	130
BERGLJOT		9
BOGASARI DUA	29	26
BOSTON	12	59
BRIGHT HOPE	1	29
C V STAGHOUND	10	93
CAMELLIA VENTURE	20	91
CARMEN A	8	27
CHALMETTE	4	
CHARLESTON	38	97
CHAVEZ	21	86
CHESMIRE	58	128
CHEVRON BRUSSELS	22	49
CHEVRON COPENHAGEN		106
CHEVRON KENTUCKY		74
CHEVRON NORTH AMERICA	42	
CHEVRON SOUTH AMERICA		59
CK APOLLO	10	148
COLUMBIA RIVER L/V	14	
COLUMBUS NEW ZEALAND	497	
CONALCO	20	92
CORANTIJN	29	
COVADONGA	12	40
CRYSTAL REED	1	29
DANWOOD ICE	18	
DAVID PACKARD	16	49
DEL ORO		89
DELAWARE II	9	68
DELTA ARGENTINA	191	194
DELTA ECUADOR	8	45
DELTA PARAGUAY	34	57
DILIGENCE WMEC 616	13	69
DOLLY TURMAN	7	
DRAGAMINAS	19	
EAGLE CHARGER	26	
EASTERN PACIFIC	30	85
EASTERN WORLD	20	
EL PASO SONATRACH	1	
ERNA OLDENDORFF	1	91
ETEE KORE	13	
EVER SUMMIT	3	
EXPORT ADVENTURER	12	63
EXPORT BAY		95
EXPORT CHAMPION	8	
EXPORT LEADER	6	17
EXXON BOSTON	26	68
EXXON HUNTINGTON	16	32
EXXON NEWARK	21	38
EXXON WASHINGTON	3	3
FEDERAL SUMIDA	16	39
FORT HOSKINS	9	
FROSTFJORD		10
GALVESTON	4	
GENEVIEVE LYKES	10	
GEORGE WALTON	19	72
GLACIER BAY	16	
GLOMAR EXPLORER	6	95
GOLDEN DOLPHIN	19	74
GOLDEN RAY	3	29
GREAT LAND	6	13
GREEN HARBOUR	69	106
GREEN VALLEY	26	
GULF SHIPPER	23	103
HARNGJIN	17	64
HELLESPONT GLORY		61
HILLYER BROWN		38
HOEGH MASCOT	9	30
HOEGH PILOT	17	34
HONGKONG PHOENIX	17	
HOWARD W BELL	21	31
HONGKONG PHOENIX	7	193
INGER	21	91
IRONWOOD WLB 297	28	99
J LOUIS	17	16
JADRAN	65	113
JAMES E O'BRIEN	3	
JAPAN AMBROSE	9	
JEAN LYKES	44	37
JOHN B WATERMAN	19	80
JOSEPH LYKES	6	35
KASHU MARU	19	62
KINGDOM VENTURE	72	26
KOREA PHOENIX	7	
KOREAN JUPITER	1	
L.W. FUNKHOUSER	2	
LAKE SHASTA	4	122
LASH PACIFICO		44
LETITIA LYKES	6	47
LLOYD CUIABA	9	89
LUIGI GRIMALDI	1	
MALLORY LYKES	25	
	19	12
ADABELLE LYKES	4	
AFRICAN DAWN		32
AFRICAN SUN	17	47
ALASKAN	18	45
ALEUTIAN DEVELOPER	24	39
ALNERIA LYKES	28	121
ALVA MAERSK	28	120
AMERICAN ACE	26	105
AMERICAN ARCHER	81	107
AMERICAN CHALLENGER	10	84
AMERICAN CORSAIR	39	107
AMERICAN LANCER	36	150
AMERICAN LEGEND	26	115
AMERICAN RACER	14	89
AMOCO CAIRO	1	
ANCO DUKE	13	98
ANNA K	5	
ANTONIA JOHNSON	30	100
ARCO FAIRBANKS	4	103
ARCO PRUDHOE BAY	6	137
ARILD MAERSK	29	88
ARTLENBURG	14	
ASIA BRAVERY	17	103
ASIA HUNTER	1	
ATLANTIC BRIDGE	1	
AUSTRAL ENSIGN	51	84
AUSTRAL MOON	81	142
AUSTRAL RAINBOW	66	119
BALD BUTTE	4	52
BARMA	26	101
BAYANO	16	89
BERNES	11	
BOHEME	3	88
BOUTWELL WMEC 719	93	105
BRAINTON LYKES	17	
C.W. KITTO		46
CAMPBELL WMEC 32	26	40
CARNIVALE	20	23
CHANCELLORSVILLE	32	68
CHARLOTTE LYKES	20	63
CHENNAI SADHANAI	8	73
CHESNUT HILL	14	26
CHEVRON BURNABY	3	
CHEVRON EDINBURGH	2	101
CHEVRON LOUISIANA	9	
CHEVRON OREGON	6	24
CHEVRON WASHINGTON	47	99
CLOVER WLB 392	29	
COLUMBUS AMERICA	17	106
COLUMBUS VICTORIA	27	122
CONFIDENCE WMEC 619	8	
CORNUCOPIA	24	28
CRESCO	11	93
CUMBERLANDIA	107	
DAUNTLESS CG	33	
DAVID STARR JORDAN	4	48
DEL RIO	8	27
DELAWARE SUN	40	78
DELTA BRASIL	6	21
DELTA MAR	7	80
DELTA URUGUAY	12	35
DISCOVERER OSS	70	104
DON CARLOS	9	27
DRUCILLA U	41	90
EASTERN BRIDE	16	34
EASTERN TREASURE	18	
EDGAR M QUINNY	14	67
EL PASO SOUTHERN	14	42
ESSO BANGKOK	19	
ESSO PROVIDENCE	16	
EVER VALUE	3	12
EXPORT AIDE	11	
EXPORT BUILDER	9	20
EXPORT COMMERCE	1	22
EXPORT PATRIOT	22	3
EXXON FLORENCE	34	49
EXXON JAMESTOWN	45	93
EXXON PHILADELPHIA	18	17
FAIRSEA	8	28
FOOTRAGE	2	2
FRANCIS SIMGERE NO 6	37	13
GALLEON CORAL	17	53
GARDENIA	34	108
GENISTA	18	32
GIBRALTAR MARU	17	30
GLADIOLUS	33	69
GOLDEN ARROW	85	48
GOLDEN GATE	17	35
GOLDEN ROD	19	103
GREAT OCEAN	4	57
GREEN ISLAND	10	123
GUAYANA	25	92
GUNDA BROVIG	1	
HARUNA MARU	93	46
HERON	33	69
HOEGH ELAN	8	9
HOEGH MERCHANT	8	29
HOEGH TRIGGER	8	
HONSHU GLORIA	68	179
HOWELL LYKES	20	19
HONSHU GLORIA	68	179
INGHAM WMEC 35	40	
ITALY MARU	30	21
J R GREY		182
JALAYANINI	28	
JAMES LYKES	13	32
JAPAN CADRO	11	61
JEFF DAVIS	10	
JOHN LYKES	19	44
JUPITER	20	
KATHY	2	
KINYO MARU	32	38
KOREAN CHALLENGER	1	
KOREAN PRIDE	19	
LAKE ARROWHEAD	4	43
LAKE TAHOE	69	118
LAUREL	64	61
LING YUNG	43	121
LONG BEACH	11	
LURLINE	36	140
MALLOW WLB 396	37	40

TOTAL WEATHER REPORTS RECEIVED FROM US COOPERATIVE OBSERVING SHIPS MARCH AND APRIL 1979

SHIP NAME	VIA RADIO	VIA MAIL
HALMROS MONSOON	6	39
MANISTEE	49	
MANULEI	82	86
MARCONA EXPORTER	44	152
MARGARET LYKES	9	49
MARITIME ACE	2	16
MASON LYKES	24	92
MAUHEE	22	71
MAYO LYKES	8	
MENKAR	1	
MIDAS ARROW	9	
MING AUTUMN	33	59
MING YOUNG	15	31
MOBIL POWER	35	44
MOBILGAS	11	60
MONTIGNY	7	
MORMACALTAIR	25	64
MORMACRIGEL	11	59
MORMACSTAR	6	37
MORMACWAVE	4	53
MUNRO WMEC 724	12	
NEPTUNE RUBY	30	
NEWARK	36	81
NOPAL SEL	8	
NORSE PILOT	56	143
OCEAN BRAVE	34	17
OCEANIC ERIN	9	
OGDEN JORDAN	12	
OGDEN WILLAMETTE	27	19
OPHELIA	1	
ORE MERIDIAN		16
ORIENTAL EXECUTIVE	14	
OTTO N. MILLER	3	198
OVERSEAS JUNEAU	13	116
PACDUCHESS	13	
PACIFIC ACE	10	3
PACIFIC GLORY	49	
PACIFIC WING	45	77
PACMERCHANT	8	
PAN ASIA	4	
PAYSANDU	41	
PEREIRA D'ECA	1	
PINE LIGHT	21	
PIONEER CONTRACTOR	12	122
POLAR ALASKA		145
PORTUGAL MARU	22	11
PRESIDENT FILLMORE	31	94
PRESIDENT JOHNSON	45	170
PRESIDENT MC KINLEY	39	121
PRESIDENT ROOSEVELT	32	47
PRESIDENT VAN BUREN	38	118
PROVINCIA DE EL ORO	8	
QUEENS WAY BRIDGE	31	19
RED ARROW		10
REVERE	43	59
RIO TUXPAN	1	
ROSE		73
ROYAL VIKING STAR	1	
SAM HOUSTON	6	39
SAMUEL S	10	6
SANKOGRAIN	1	
SANTA CLARA		58
SANTA MERCEDES	11	43
SEA FAN	8	35
SEALAND ECONOMY	40	115
SEALAND LEADER	12	92
SEALAND PRODUCER	14	
SEALIFT ATLANTIC	5	116
SEATRAIN CONCORD	54	20
SEATRAIN TRENTON	98	148
SEDGE WLB 402	37	
SEVEN OCEAN	23	16
SHIRLEY LYKES	16	41
SINCERE NO 5	4	10
SNOWFLAKE	6	
SOLON TURMAN	20	66
STADT BREMEN	50	
STEADFAST WMEC 623	12	
STORIS WAGB 38	25	
SUCCESSFUL VENTURE	17	14
STORIS WAGB 38	24	
SURVEYOR	77	203
T P L LIBERTY	11	116
TAMPA	45	111
TERRIER	10	
TEXAS TRADER	15	106
THOMAS LYNCH	1	
TOKYO RAINBOW	14	96
TOWNSEND CROMWELL	64	161
TRANSCHAMPLAIN	67	156
TREIN MAERSK	15	25
UNIMAR WTR-379	24	31
UNIVERSE	7	
VAN CONQUEROR	37	135
VANGUARD	36	130
VERRAZANO BRIDGE	29	33
VIOLET	60	99
WASHINGTON TRADER	3	
WESTERN SUN		52
WILMINGTON GETTY	15	33
WYOMING	21	
YOUNG AMERICA	13	89
ZIM HONGKONG	17	
ZOELLA LYKES	6	
BLEL	1	19
DZJF		191
D5MC	6	26
D7DL	5	5
ELPA	7	13
HDDT		163
HPLK		51
JJBO	21	21
JLUL	10	13
KFEV		35
KGWV		38
KIKX		11
KYKN		13
N8SI		100
NTRI		94
S6ED	31	73
WGWU		34
WNJF		30
WY53261		78
ZCKV	22	77
3FBR	5	23
3FWC	4	49
5GPY		10
5MMP	14	7
5WCC		58
6ZMT	7	40
8HCC	9	14
MAMMOTH PIR	31	74
MANUWAILI	72	168
MANZANARES	19	61
MARCONA TRADER	24	77
MARIA TOPIC	6	121
MARITIME FORTUNE	15	
MATHIESON	18	
MAYA PIONEER	2	92
MEDITERRANEAN CARRIER	42	31
MEONIA	34	111
MIDAS RHEIN	17	53
MING LEADER	14	
MOBIL AERO		23
MOBILE	5	6
MODOC WMEC-194	12	19
MOON RIVER	2	98
MORMACARGO	12	63
MORMACSAGA	31	16
MORMACSUN	7	
MORNING GLORY	20	134
NANCY LYKES	18	37
NEW ENGLAND HUNTER		61
NEWCASTLE CLIPPER	117	
NORDHVAL	42	
NORTH STAR III	12	38
OCEAN DUKE	7	
OCEANOGRAPHER	139	109
OGDEN MISSOURI		45
OJI GLORIA	47	60
ORANGE	69	
ORIENTAL CHEVALIER	1	
ORIENTAL LEADER	24	86
OVERSEAS ALEUTIAN	50	
OVERSEAS NATALIE	22	75
PACDUKE	3	10
PACIFIC ARROW	85	67
PACIFIC PEACE	8	
PACKING	7	14
PACPRINCE	28	
PAN PACIFIC	34	80
PEIRCE	11	
PERSIAN REEFER	1	64
PINK SKY	5	
PIONEER CRUSADER	26	77
POLAR SEA	204	240
PRESIDENT ADAMS	15	37
PRESIDENT HARRISON	13	30
PRESIDENT KENNEDY	35	113
PRESIDENT MONROE	3	37
PRESIDENT TAFT	46	129
PRESIDENT WILSON	8	
PURE OIL	28	111
QUINTINA	14	
RED JACKET	6	18
RICHARD	68	105
ROBERT E LEE	2	13
ROSE CITY	21	92
RUDE ASV90	1	
SAHDA	48	97
SAN FRANCISCO	17	99
SANKOSTAR	10	
SANTA FE	2	
SANTA AMARO	42	
SEA SOUNDER	40	
SEALAND EXCHANGE	49	117
SEALAND MARKET	45	106
SEALAND RESOURCE	30	98
SEALIFT PACIFIC	3	44
SEATRAIN INDEPENDENCE	18	119
SEATRAIN YORKTOWN	52	138
SELANDIA	20	64
SHELDON LYKES	20	71
SHUNWIND	40	94
SINCLAIR TEXAS	25	130
SNOWLAND	19	79
SONGKHLA	3	
STAR DOVER	12	
STELLA LYKES	28	
STREAM HAWSER	15	
SUGAR ISLANDER	21	64
STREAM HAWSER	15	
SUSQUEHANNA	11	68
TAI SHOU	36	38
TANEY WMEC 37	51	62
TEXACO MISSISSIPPI	2	7
TFL DEMOCRACY	20	
THOMPSON LYKES	11	44
TOLUCA	4	
TOYOTA MARU 10	121	65
TRANSCOLORADO	13	76
TRIUMPH	45	
UNION PROGRESS	7	26
UNIVERSE KURE	28	174
VAN ENTERPRISE	40	102
VELMA LYKES	1	26
VICENTE GUERRERO	12	46
VOLNAY	53	
WAYFARER	3	
WESTWARD VENTURE	44	87
WORLD MEDAL	31	
YAMASHIN MARU	111	105
YOUNG SEAGULL	8	49
ZIM MONTREAL	5	29
A8GZ		110
C5QK	8	25
D5CK	3	28
D5QH	4	31
D7SF	29	22
GUEB		37
HDNL	10	38
H3SY		141
JK7Q	17	19
JQCO	23	104
KFPG		9
KHLO	5	66
KMKM		16
LEVH	23	60
NHNP	1	63
OWNK		7
TCCH	60	77
WHOS		4
WSNB	5	18
WZL9190		34
ZPC8	18	30
3EQV	13	52
3EXC	24	57
5LSW		30
5MQS	7	15
6MJH	2	4
6ZQU	1	9
9VVD	63	183
MAMMOTH PINE	6	29
MANUKAI	69	136
MAR DE CORTEZ	22	100
MARCONA TRANSPORTER	31	103
MARIA U	28	
MARJORIE LYKES	17	62
MATSONIA	54	138
MAYAGUEZ	22	133
MELVILLE	26	74
MERCY	12	
MIDGETT WMEC 726	27	32
MING SPRING	53	71
MOBIL ARCTIC	16	84
MOBILE MERIDIAN	27	132
MONMOUTH	1	71
MORANT	25	
MORMACDRACO	12	58
MORMACSEA	16	45
MORMACTIDE	28	104
MOZART FESTIVAL	7	
NECHES	29	37
NEW ENGLAND TRAPPER		63
NOPAL BRANCO	5	
NORDIC LOUISIANA	37	
NORTHERLY TRADER	1	
OCEAN HARMONIA	48	
OCTA	2	
OGDEN SENEGAL	2	99
OLEANDER	109	64
ORCO TRADER	11	
ORIENTAL COMMANDER	7	51
ORIENTAL SOVEREIGN	38	61
OVERSEAS ARCTIC	10	37
OVERSEAS WASHINGTON	11	17
PACEMPEROR	2	
PACIFIC ERA	48	112
PACIFIC SAGA	29	37
PACLADY	17	
PACPRINCESS	6	
PARALLA	22	32
PENNMAR	5	
PHILADELPHIA	34	73
PIONEER COMMANDER	34	39
PIONEER MOON	12	67
POLAR STAR WAGB-10	14	19
PRESIDENT CLEVELAND	17	102
PRESIDENT JACKSON	9	48
PRESIDENT LINCOLN	1	
PRESIDENT PIERCE	64	138
PRESIDENT TAYLOR	18	42
PRINCE WILLIAM SOUND	24	67
PVT JOHN R TOWLE	12	
QUIXADA	4	8
RELIANCE WMEC 615	2	
RIGOLETTO	19	17
ROBERT TOOMBS	11	56
ROYAL VIKING SEA	2	9
RUTH LYKES	4	4
SANDAN REEFER	1	1
SAN JUAN	72	145
SANKOSUN	14	
SANTA MAGDALENA	25	48
SARGODHA	26	101
SEALAND COMMERCE	45	113
SEALAND FINANCE	42	94
SEALAND MCLEAN	38	92
SEALAND TRADE	45	104
SEATIGER	11	32
SEATRAIN LEXINGTON	59	155
SEAWAY	72	269
SENTINEL	13	29
SHERMAN WMEC 720	4	30
SILVERLIME		84
SKYWARD	38	53
SOCONY VACUUM	9	52
SOUTHWARD	36	33
STAR HONGKONG	16	43
STOLT LLANDAFF	4	28
STREAM RUDDER	1	
SUNBAWA	7	33
STREAM RUDDER	1	
SVENDBORG MAERSK		68
TALUGA T-AO-62		12
TARPON		36
TEXAS	7	
THIRLBY	1	
TILLIE LYKES	45	197
TOHAMI MARU	42	24
TOYOTA MARU 14	33	43
TRANSCOLUMBIA	2	39
TROLL LAKE	59	
UNITED SEA ANDEL	8	89
USNS MIRFAK	14	36
VAN TRIUMPH	9	11
VEMA	1	
VIGOROUS WMEC-627	30	95
WALTER RICE	49	159
WECOMA	45	104
WESTWIND WAGB 281	1	
WORLD RUBY	49	54
YBH YUNG	10	
YUKON T-AO 152	3	42
ZIM NEW YORK	30	77
A8TV		33
D4BR		63
D9ES	38	111
D7EG		24
ELFY		207
GZVK	10	37
HOGJ		45
JCJE	33	28
JKMG	76	52
JUDL		14
KPGV		27
KHSB		11
KSLJ	34	103
LGPZ		99
NMOS	38	53
OYNB	29	76
VPPJ	10	19
WIEO		33
WMRN		45
WZY9373		72
9BBA	17	11
9EJE	12	47
9FEQ	6	20
9MAH		2
9MTJ	60	57
9ZBT		29
6ADD		1
9VVD	15	47
MANHATTAN	21	66
MANULANI	52	123
MARCONA CONVEYOR	3	14
MARDI GRAS	31	61
MARIAS TAO-57		69
MARY S	1	
MAUI	49	132
MAYAYAN REEFER		32
MELVIN H. BAKER	73	
METEOR T-AKR 9	23	40
MILLER FREEMAN	41	65
MING SUMMER	12	15
MOBIL LUBE		29
MOBILFUEL	31	151
MONTERREY	4	
MORGENTHAU WMEC 722	3	16
MORMACLYNX	18	58
MORMACSKY	27	136
MORMACVEGA	35	69
MT MITCHELL	24	
NEPTUNE LEO	49	37
NEW JERSEY SUN		13
NOPAL LANE	5	
NORDIC PRINCE	17	
NOVIA	15	
OCEANIC	81	170
OGDEN CONGO	21	44
OGDEN WABASH	1	
OLGA TOPIC		9
ORE JUPITER	28	104
ORIENTAL EDUCATOR	40	30
ORIENTAL STATESMAN	5	38
OVERSEAS JOYCE	8	37
PACBARON	15	
PACGLORY	13	
PACIFIC EXPRESS	71	35
PACIFIC VENTURE	11	66
PACMAJESTY	8	
PACSTAR	12	13
PAUL L FAHRNEY		18
PENNSYLVANIA SUN	1	
PHILLIPS OKLAHOMA	2	
PIONEER CONTENDER	4	55
PLANETREE WLB 307	53	
PORTLAND	37	83
PRESIDENT EISENHOWER	43	144
PRESIDENT JEFFERSON	37	137
PRESIDENT MADISON	58	138
PRESIDENT POLK	37	113
PRESIDENT TRUMAN	27	131
PROSPERITY QUEEN	3	22
PVT LEONARD C BROSTROM	14	62
RAINIER	1	
RESEARCHER	55	133
RIO OLIVIA	31	22
ROBERTSBANK	30	82
ROYAL VIKING SKY	6	72
SALVADOR	30	28
SAMUEL CHASE	1	73
SAN MARCOS	92	138
SANSINENA II	29	115
SANTA MARIANA	13	37
SCHUYLER OTIS BLAND	1	15
SEALAND CONSUMER	21	
SEALAND GALLOWAY	31	110
SEALAND PIONEER	20	111
SEALAND VENTURE	35	121
SEATRAIN BUNKER HILL	34	176
SEATRAIN PRINCETON	43	137
SEAWAY DISPATCH	4	3
SEPTA	27	58
SHING ON	31	
SINCERE NO 9	7	
SNOW STORM	2	16
SOHIO INTREPID	1	
SPRUCE	10	3
STATE OF TRIPURA	39	74
STONEWALL JACKSON	9	59
STUYVESANT	34	138
SUNNY STATE	2	
STUYVESANT	34	138
T P L INDEPENDENCE	39	100
TAMARDA WMEC-166	27	23
TAUBE	41	74
TEXAS SUN		45
THOMAS G THOMPSON	40	16
TOBIAS MAERSK	4	29
TONCI TOPIC	22	134
TOYOTA MO 24	19	26
TRANSONEIDA	32	126
TROPIC EVE	1	
UNITED SPIRIT	9	
VALLEY FORGE	16	70
VAN WARRIOR	21	86
VENTUROUS WPC 625	5	
VILLANGER	7	
WASHINGTON RAINBOW		122
WEGER EXPRESS	94	126
WILLI REITH	20	
WORLD SUPREME	14	19
YOCONA WMEC 168	4	
ZENLIN GLORY	7	49
ZIM TOKYO	33	79
A8WB	10	116
DVXL		79
D9IY	27	63
D7EN	3	54
ELJN	13	24
HDAW		10
HPBA		3
JMJZ		65
JLJL	61	54
KCIP		6
KFZV		16
KING		50
KWPF		39
LNDL	1	21
NIUB		7
S6HZ		31
WFQE	27	149
WNEP		10
WRMJ		49
WSOX		77
3EBH	11	27
3EOU	48	68
5DOM		20
5MNE		46
5EMS		12
6ZLH	8	32
8JJJ	21	103
9VVP		1

SUMMARY: GRAND TOTAL VIA RADIO 21659 GRAND TOTAL VIA MAIL 51810

Rough Log, North Atlantic Weather

June and July 1979

ROUGH LOG, JUNE 1979--Most of the storms over Canada dissipated as they approached the Labrador Sea and Baffin Bay. The primary path of those storms that affected the mariner was northeastward along the east coast of the United States toward Kap Farvel and eastward across Iceland to the North Sea. The traffic was light. There were individual tracks across the water as far south as the Azores. Only those tracks across Canada and along the east coast of the United States closely followed the climatic paths.

The mean sea-level pressure pattern (fig. 65) was not grossly different from climatology. The Icelandic Low had two 1007-mb centers, one between Kap Farvel and Iceland and the other over the Davis Strait. This compares to the two 1009-mb climatic centers near 60°N, 35°W, and Cape Chidley. The Azores High was larger than normal, with two 1025-mb centers near 40°N, 20°W, and 33°N, 46°W. The climatic center is 1024 mb near 33°N, 35°W. The eastern ridge stretched farther into Europe and the Mediterranean Sea than usual.

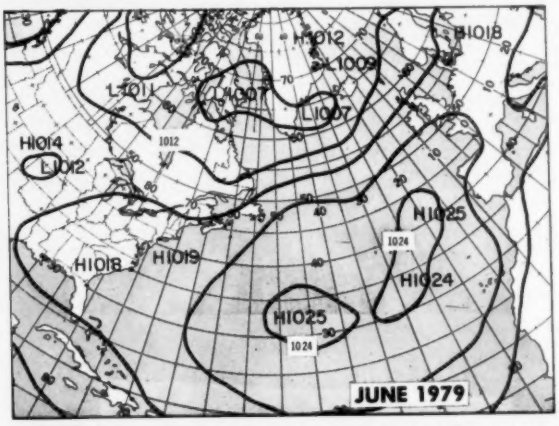


Figure 65.--Mean sea-level pressure for the North Atlantic, June 1979.

The anomaly analysis indicated that the pressure was greater than normal south of 60°N (using a gross approximation). The only significant area of negative values surrounded Greenland with the largest being 4 mb.

The upper air pattern at 700 mb closely resembled its climatic counterpart. The primary center of circulation was near the North Pole. A second center was over Baffin Bay. There was a short-wave trough off the U.S. East Coast, another west of the Azores, and the usual one over Portugal. Ridging over eastern Europe was more pronounced than normal.

Tropical storm Ana formed east of the Lesser Antilles.

Extratropical Cyclones--After the last storm in May dissipated north of the Azores during the first few days of this month, high pressure built in that area. A low-pressure center that left Nova Scotia on the 1st traveled southeastward, but it had little effect and was defeated by the HIGH. From the first week of the month through the second week the major part of the ocean was one large anticyclonic circulation with several small weak LOWs interspersed. During the last third of the month, larger LOWs developed and made greater inroads in the high pressure.

The first severe marine storm of the month formed with the combining of two low-pressure centers. On the 10th a frontal wave was over Ontario and another LOW was over northern Hudson Bay. On the 11th the northern LOW became the major center of circulation and intensified. At 1200 it was 972 mb near 64°N, 70°W. As the front moved off the U.S. East Coast the DART CANADA at 41°N, 65°W, found southerly 37-kn winds on the 12th at 0000. North of the 970-mb LOW, Cape Dyer and another weather station on the Baffin Bay coast of Baffin Island had northeasterly 35-kn gales. At 0600 the DISKO near 66°N, 54°W, had 37-kn winds from 160° and a pressure of 991 mb. At 1200 the KUNUNGUAK (64°N, 52°W) found 44-kn winds from 160° and 995 mb (fig. 66). Godthab on the coast measured 40-kn winds. The pressure was rising rapidly, and by midday on the 13th the LOW no longer existed.

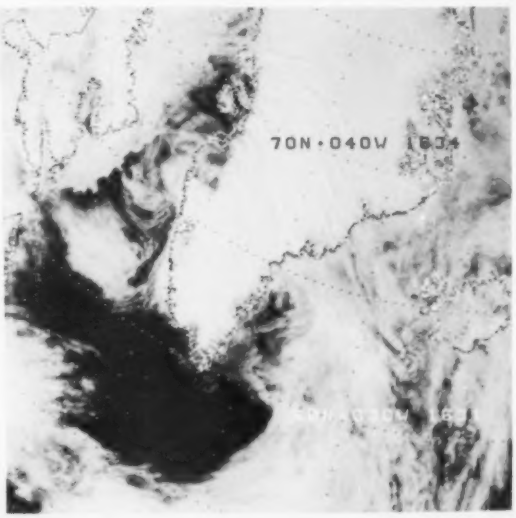


Figure 66.--The storm is centered over Baffin Strait on the 12th. Ice is still clinging to the shore of Baffin Island.

As the LOW on the west coast of Greenland died, this one sprang into being off the east coast late on the 12th. At 1200 on the 13th the 993-mb LOW was over Iceland. At 1800 the ZIEMIA KRAKOWSKA was south of the Island at 57°N and reported 62-kn winds. There is a good possibility that the windspeed was doubled in decoding. On the 14th other ships in the area were re-

porting 35 to 40 kn. At 0600 the JOHN MURRAY (59°N, 11°W) radioed 40-kn winds with 20-ft seas and 25-ft swells. At 1200 the KRAKOWSKA repeated the high-wind report near 56°N, 22°W, this time with 20-ft seas and swells (fig. 67).

The storm was traveling southeastward and by 1200 on the 15th had moved over Germany.

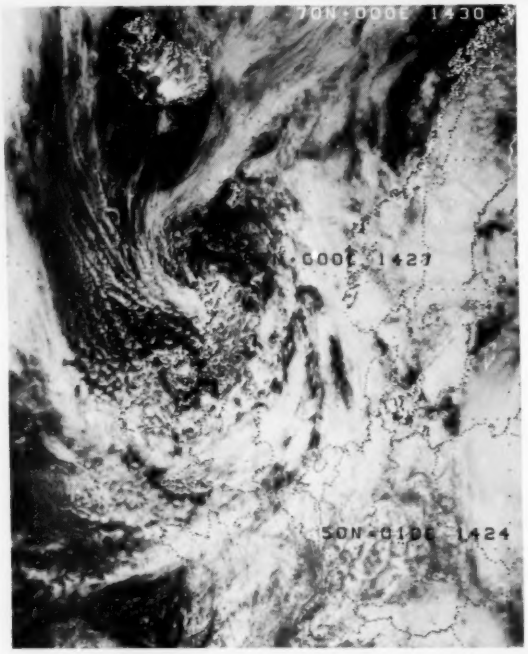


Figure 67.--The LOW is centered over the Outer Hebrides Islands. Iceland appears to split the southward-flowing cold air with clear skies in the lee flow.

On the 15th there was a large area of weak low pressure southeast of Newfoundland. By midday on the 16th this had consolidated into one 1000-mb LOW near 42°N, 42°W. The TILLIE LYKES found 17-ft waves 200 mi southeast of the center. On the 17th the ZEALANDIC reported 23-ft waves near 46°N, 33°W. By the 18th the LOW had dissipated into a trough.

Weak frontal waves were traveling along a generally east-west front that lay across the Great Lakes. As one of these moved over the Maritime Provinces it gained enough energy to continue to develop. At 1200 of the 19th the storm was 1000 mb near 49°N, 47°W, and the ZAPATA RANGER was nearby with 37-kn southerly winds. At 1200 of the 20th the storm was near 54°N, 27°W, and turning more northeasterly (fig. 68). Three ships to the south had 12- to 15-ft waves. On the 21st the storm was moving toward the Shetland Islands. The BEN OCEAN LANCER was west of the center with 40-kn winds. Several ships had 14-ft waves. On the 22d OWS Lima measured 37-kn winds and 16-ft swell waves. Several other ships had winds and waves of the same strength. A few hours later a LOW over Iceland absorbed this one. Lima measured 40-kn winds and 23-ft swell waves with this LOW.

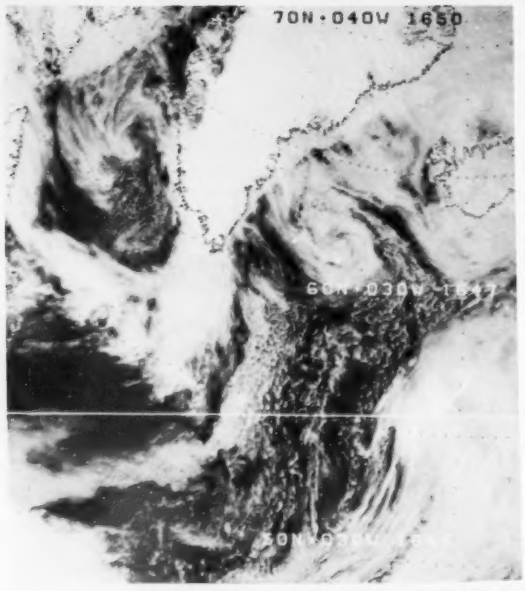


Figure 68.--The major LOW is near 54°N, 27°W, but the smaller LOWs straddling southern Greenland are more distinct in their cloud pattern.

High pressure centered over the Great Lakes on the 25th brought record cold temperatures to many northeastern and central Atlantic U.S. cities on the morning of the 26th.

This LOW showed up on the 1200 analysis of the 26th east of Kap Farvel. Twelve hours later at 0000 on the 27th the HUDSON near 60°N, 50°W, had 35-kn winds. At 1200 the MINERAL HOBOKEN was sailing eastward along 50°N with 20-ft swell waves. As the storm moved over Iceland on the 28th, it treated several ships to 35- to 40-kn gales. One was Lima with 20-ft waves. Another was the MANCHESTER CONCORDE (56°N, 33°W) with 21-ft swells. The center of the storm moved against the Norwegian coast on the 30th and tracked northeastward along the coast until July 2, when it turned northwestward into the Greenland Sea. Jan Mayen measured 40-kn winds.

Tropical Cyclones--Ana was the first June storm to develop east of the Lesser Antilles since 1933 and only the second in 100 yr of record. Ana was earlier, but the 1933 storm developed farther to the east.

The disturbance which was to become Ana left the African west coast on the 14th. The first evidence of a tropical depression came on the morning of the 19th when satellite pictures showed that a circulation was developing near 10°N, 45°W. The depression moved west-northwestward at about 12 kn until late on the 20th, when it slowed and turned to the northwest. Some slight strengthening occurred at this time. Air Force reconnaissance reports indicated the depression was near tropical-storm strength late on the 21st.

Ana was named on the 22d, and gale warnings were issued for the islands from Martinique to Guadeloupe. However, strong westerlies at high levels began shearing the convection from the circulation center, and Ana

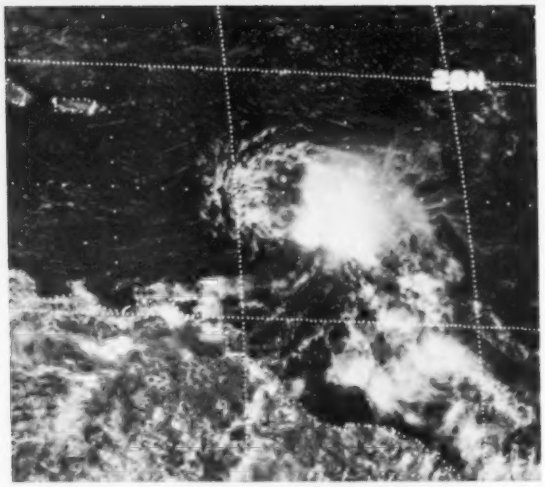


Figure 69.--Tropical storm Ana at her peak.

reached the islands as a minimal tropical storm late that day. Continued weakening took place as the storm turned more to the west. Ana was downgraded to a tropical depression on the morning of June 23 and to a tropical wave in the central Caribbean the following day.

Maximum sustained winds in Ana were estimated to be 50 kn on the morning of the 22d with the minimum central pressure of 1005 mb also occurring at that time (fig. 69). There was no heavy rainfall in the islands and no reports of gale-force winds. No deaths or significant damage have been reported.

Casualties--The 104,000-ton American tanker BROOKLYN allegedly sustained heavy-weather damage on the 10th on a voyage Arabian Gulf to Curacao. The 16,033-ton Panamanian bulkcarrier GLORIOUS was in Rotterdam with heavy-weather damage from June 10 to 13. The 27,499-ton Liberian bulkcarrier ATLANTIC SEATRADE also suffered heavy-weather damage June 9 to 13.

The 14,245-ton Liberian REGAL SWORD and the 17,327-ton EXXON CHESTER (fig. 70) collided in fog off Cape Cod. The REGAL SWORD sank, but all the crew was rescued by the EXXON CHESTER.

In another collision in fog off the west coast of Italy the 4,942-ton Italian tanker VERA BERLINGIERI and 12,202-ton French freighter EMMANUEL DELMAS both caught fire (fig. 71). Rescue ships picked up 23 of the 24 crewmembers of the Italian ship and 3 of the 30-man crew of the French ship. The VERA BERLINGIERI sank and the EMMANUEL DELMAS was towed to Cititavecchia Roads.

The 1,950-ton British-registered SHOREHAM ran aground on rocks at Mullion in fog on the 28th. On the 29th the 68,807-ton natural gas carrier EL PASO PAUL KAYSER ran aground in the Strait of Gibraltar in fog.

Figure 70.--The crumpled bow of the tanker EXXON CHESTER shows what happens when two ships try to occupy the same spot at the same time. Wide World Photo.

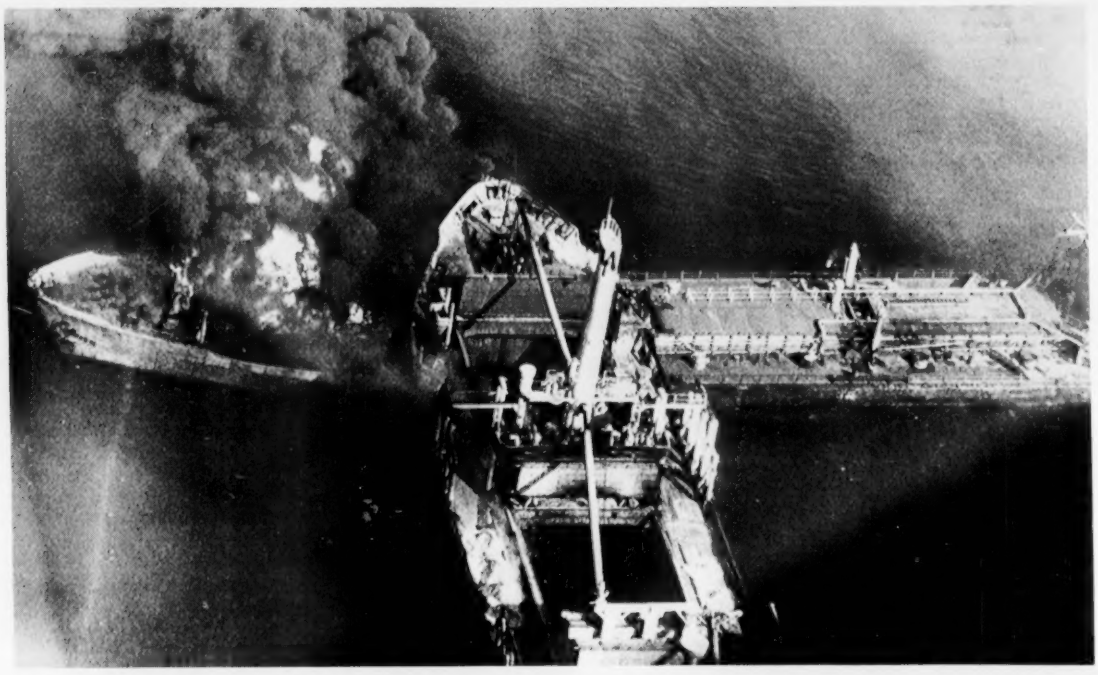


Figure 71.--This aerial photograph was taken prior to the two ships being separated. The tanker VERA BERLINGIERI sank later, and the EMMANUEL DELMAS was towed to port. Wide World Photo.

ROUGH LOG, JULY 1979--The storm tracks this month closely followed the climatological pattern with some shifts in geography. Two primary paths, one from over the Great Lakes and one from the U.S. East Coast, met between St. John's and Kap Farvel to continue over Iceland. There were several cyclones over Scandinavia and over or near the Iberian Peninsula. A climatological track over Hudson Bay turned sharply northward over Baffin Island. The difference from the climatic tracks was the location of one track farther south than usual over the Great Lakes. Another difference was the joining of the two tracks south of Kap Farvel.

The Azores High dominated the North Atlantic from latitude 10° to 6[illegible]°N in the mean (fig. 72). It ridged sharply into France and the eastern United States. Its mean center was 1029 mb near 37°N, 33°W, which was 4 mb higher and about 300 mi northeast of its climatic position. There were three weak LOWs across the subpolar region as climatology indicates. A 1005-mb center over Baffin Island was about 400 mi north of its normal position. A 1009-mb LOW was normally positioned over Iceland as was a 1008-mb center over the Gulf of Bothnia.

Positive anomalies stretched from 10° to 60°N latitude and the Mississippi River eastward to the U.S.S.R. The largest were 6 mb off Brest and 4 mb near the center of the High. Significant negative centers were minus 5 mb over Baffin Island and minus 3 mb over the Baltic Sea.

In the upper air at 700 mb the primary differences

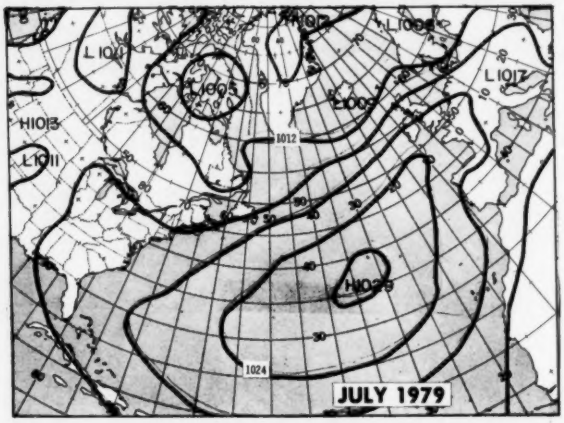


Figure 72.--Mean sea-level pressure, North Atlantic, July 1979.

from climatology were closed LOWs corresponding to the surface LOWs in the subpolar region. Each surface LOW had a corresponding closed circulation at 700 mb. These are normally only reflected as troughs at 700 mb. The flow across the major shipping lanes was primarily zonal.

Hurricane Bob and tropical storm Claudette were named this month. This is one more than the long-term average. There was also a tropical depression.

Both storms brought heavy rains inland, especially Claudette, which was a minimal storm.

Extratropical Cyclones--The Bermuda-Azores High was the dominant feature this month, with transitory LOWs moving over and along its western and northern edge. Several times during the month the High retreated southward and/or split into multiple centers, thus allowing LOWs to develop and to penetrate farther south, particularly over or east of the Iberian Peninsula.

The first storm of the month came out of the Great Lakes. At 1200 on the 3d it was 990 mb over the Gulf of St. Lawrence. The weather station at Mt. Washington reported 40-kn winds. On the 4th OWS Charlie measured 37-kn winds and 15-ft waves. On the 4th the swell increased to 16 ft. The THOMAS CARLETON on the Bay of Fundy had 56-kn northwesterly winds as a trough passed and probably partially due to funneling. Wind gusts to 60 kn were recorded at Frying Pan Light Tower in North Carolina. On the 6th the LOW broke up over Kap Farvel. High pressure following the LOW again brought record summertime low temperatures to the northeastern part of the United States. Washington, D.C., set a new record this summer when the temperature did not reach 90°F until July 12.

This storm formed as a frontal wave off Delaware Bay on the 5th. The front stretched out of the previous LOW. By 0000 on the 6th the central pressure had plunged to 982 mb over Cabot Strait (fig. 73). Mount Washington Observatory, N.H., recorded 79-kn winds. The CETRA CARINA was 500 mi south of the center with 50-kn northwesterly winds. Five Canadian ships in the vicinity reported 35- to 42-kn winds near 45°N, 60°W. None reported waves. An American ship, the WWBB, had reported 38-kn winds from the northeast north of the center at 2100 on the 5th. At 0300 on the 6th the LUCY MAUD MONTGOMERY (47°N, 62°W) had 50-kn winds with a pressure of 986 mb. The SAM HOUSTON found 20-ft seas at 1200 about 400 mi south of the 982-mb center.

On the 7th gales were still being reported, and OWS Charlie had 37 kn late in the day with waves as high as 20 ft. On the 8th Lima measured 35 kn, and the C.P. VOYAGEUR had squalls with 15-ft swells. The ARNI FRIDRIKSSON was off the east coast of Iceland at 1800 with 49-kn easterlies. The LOW stalled several times as it approached Iceland and weakened and finally dissipated over Scoresby Sound.

This LOW can be traced back to its origin near Mackenzie Bay on the Beaufort Sea on the 5th. It traveled southeastward across northern Canada as a weak LOW or frontal wave before crossing into the Labrador Sea on the 9th. Although the LOW was very weak (999 mb) on the 10th, there was a tight gradient between it and the Azores High (1034 mb). The DAWSON was east of St. John's with 37-kn winds. Later Charlie had 35-kn gales and 18-ft waves. At 0000 on the 12th the LOW was 995 mb south of Iceland (fig. 74). The POLARNYY KRUG was near 56°N, 32°W, with strong 45-kn gales. At 0600 the MANCHESTER CRUSADE had 38-kn winds near the same position, and at 1200 Lima measured 40-kn winds from the southwest. On the 13th the seas were 15 ft. The storm moved over Iceland on the 13th and dissipated over the Greenland Sea.

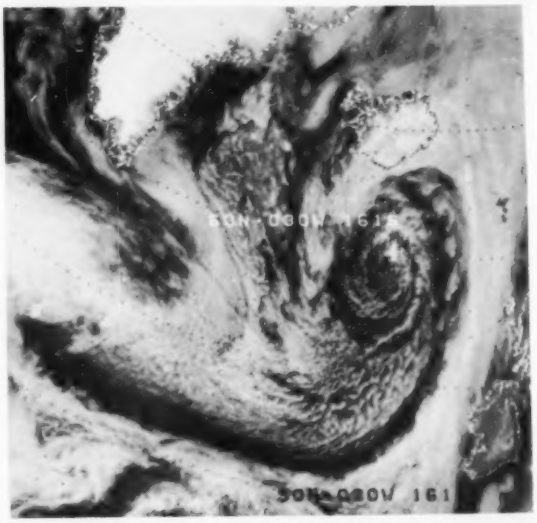


Figure 74.--Each storm has a different signature. This is what makes forecasting so difficult.

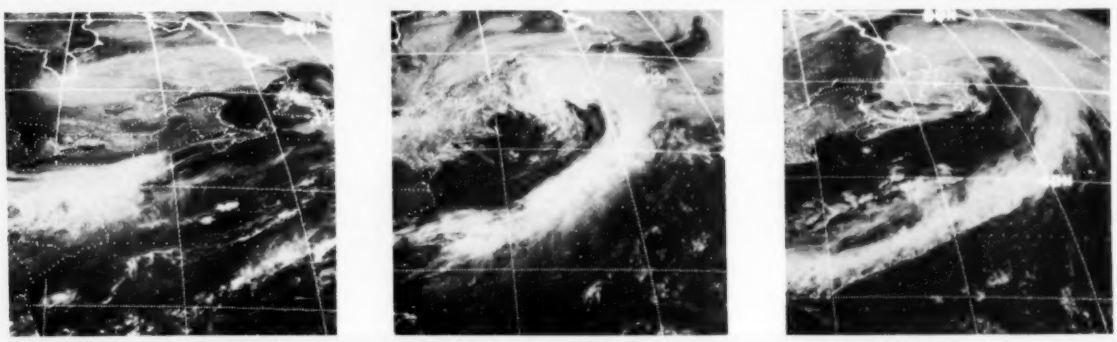


Figure 73.--This sequence of three SMS images for 1700 on the 4th, 5th, and 6th portrays this rapidly developing storm.

With the demise of tropical depression No. 4 well east of Cape Hatteras, a wide low-pressure trough remained. Two small extratropical centers were apparent at 1200 on the 12th. The SUSAK was near the northern center with 37-kn southerly winds. At 1800 the NOVO MESTO (37°N, 61°W) was east of a sharp trough line with 48-kn winds from the south; at 0000 on the 13th they had shifted to westerly. The ASIAN RENOWN at 54°N, 46°W, was very near the 993-mb center at 1800 on the 14th with 50-kn winds (fig. 75). On the 15th OWS Charlie measured 35-kn winds and 16-ft seas.

The storm sailed south of Iceland on the 16th, and there were gale reports from fishing vessels in the area. The storm drifted across the Norwegian Sea and dissipated over the Gulf of Bothnia on the 22d.

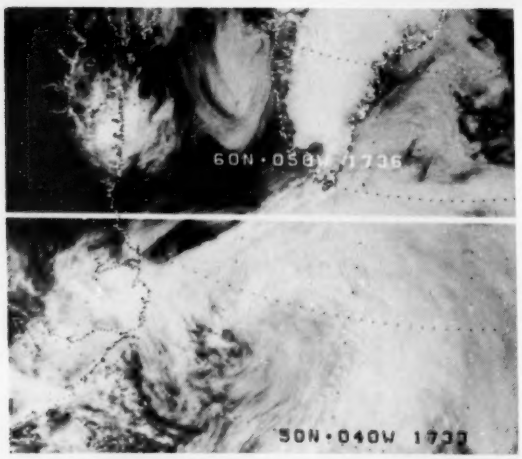


Figure 75.--Only the circulation center of the high clouds can be seen. It is near 56°N, 48°W, showing the slope of a cold cyclonic system toward the cold air.

This very short-lived storm only affected a few ships. It developed as a frontal wave over Labrador by 0000 on the 23d. At 1200 it was over the Labrador Sea, and the LABRADOR off Hopedale had northerly 41-kn winds. At 1800 the KUNUNGUAK was in Davis Strait with 46-kn southerly winds. By 1200 on the 24th the LOW had disappeared south of Kap Farvel.

Among others an observation from the SEA-LAND GALLOWAY was instrumental in first analyzing this frontal wave on the 21st. Her wind direction and barometric pressure were especially important. The LOW was very shallow for the first 3 days, supported by only a trough at 10,000 ft. It wandered around the area near 48°N, 40°W, until the 24th when a closed LOW appeared at 700 mb. On the 25th the CAPE ROGER (47°N, 46°W) found 35-kn gales and 13-ft seas. At the time the LOW was 998 mb near 50°N, 33°W. At 2100 the ESCHERSHEIM was in the southwest quadrant with 37 kn and 16-ft seas.

On the 27th at 0600 OWS Charlie was northwest of the center and measured 41-kn winds. The storm moved almost directly over OWS Lima at 0000 on the 28th and plunged southward to disappear.

Tropical Cyclones--Hurricane Bob developed from one of many disturbances that originate over Africa each hurricane season. It was first detected in the eastern North Atlantic near the Cape Verde Islands in the last week of June. The system continued westward without showing any signs of development until it reached the northwestern Caribbean on July 6. It crossed the Yucatan Peninsula, and a weak circulation began forming on the 8th and organized into the third tropical depression of the year the following day.

On the morning of the 10th Air Force reconnaissance aircraft reported a developing tropical storm about 400 mi south of the Louisiana coast with maximum winds of about 50 kn and a pressure of 998 mb, a drop of 14 mb since the flight the previous day. Afternoon flights measured winds of 60 to 70 kn and a pressure of 988 mb. The storm was upgraded to a hurricane late that afternoon, and it remained a minimal hurricane with lowest pressure of 986 mb as the center moved inland west of Grand Isle, La., early on the 11th (fig. 76).

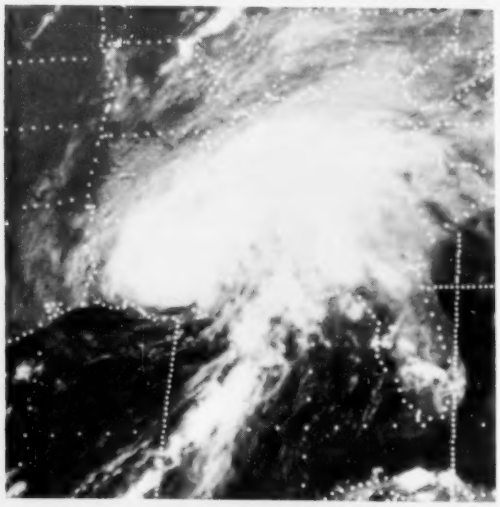


Figure 76.--Bob is inland over Louisiana at 1700.

After moving inland Bob moved north-northeastward up the Mississippi Valley into western Tennessee on the 12th and into southern Ohio on the 13th. Thereafter, the low-pressure area that was once Bob drifted southeastward off the mid-Atlantic coast on the 16th and was absorbed into a low-pressure system over the western Atlantic.

Statistics associated with Bob are typical of a minimal hurricane. Tides were generally 3 to 5 ft above normal, and rainfall totals were between 3 to 6 in. The highest winds were 45 to 55 kn along the coast, with a few locations reporting 65 kn. Eight tornadoes were reported, but only one produced significant damage estimated at $27,500 in Biloxi, Miss. There was one death and one injury in Lafitte, La., when two men were blown off a marina roof during the height of the storm. No serious flooding was reported in Louisiana, Mississippi, or Alabama, but the remnants of Bob produced flooding over portions of Indiana, Ohio, and West Virginia. A number of boats were sunk or damaged, and there was considerable pier damage from high tides and rough seas. Besides the usual downed

trees and powerlines, gusty winds broke windows in the business district of New Orleans. Total storm damage may reach several million dollars, which includes about $250,000 in Harrison County, Miss.

Tropical storm Claudette developed twice from a tropical wave. The first time, on the 16th, she was some 400 mi east of Guadeloupe. Moving west-northwestward, she intensified to tropical-storm strength on the 17th as she approached the Leeward Islands. Maximum winds reached 40 kn in squalls as Claudette moved through the Virgin Islands and about 25 mi to the north of San Juan. Its passage close to Puerto Rico and across the Dominican Republic caused Claudette to weaken to a depression and then to a tropical wave.

It was this wave that entered the Florida Straits on the 20th. By the afternoon of the following day, a depression had formed west of Key West. A ridge at upper levels stretched from the Atlantic across the southeastern United States into Texas. This ridge kept the depression on a slow west-northwest course across the Gulf to a point 225 mi south-southwest of Lake Charles, La. At this point on the morning of the 23d, the depression became minimal tropical storm Claudette.

On the 23d and 24th a short-wave impulse dipped out of the westerlies long enough to break down the ridge over Texas. This allowed Claudette to move northward making landfall around 2 p.m. CDT on the 24th in southwestern Louisiana about 17 mi west of Cameron. The storm was downgraded to a depression that same evening. Once Claudette was inland, the short wave retreated to the north cutting off the low-pressure remains of Claudette from the westerlies. This left the low pressure stalled over southeastern Texas through the morning of the 26th. On the 26th and 27th the LOW drifted northward through eastern Texas, Oklahoma, and Arkansas. On the 28th the LOW began moving more rapidly to the northeast through the Ohio Valley, gradually filling.

Through much of its lifetime tropical storm Claudette was erratic and disorganized. After reaching tropical-storm strength south of Lake Charles on the 23d, it became disorganized the night of the 23d and was downgraded to a depression, only to have a new center form the morning of the 24th and once again become a tropical storm. It appears that Claudette reached her maximum intensity shortly before landfall. After moving inland the low pressure strengthened some the night of the 25th and 26th. This undoubtedly contributed to the heavy rain in Texas.

Claudette's highest recorded wind was a gust of 52 kn and highest sustained wind 34 kn, both in Port Arthur, Tex. Unconfirmed gusts to 59 kn were reported at Grand Isle, La., as a band of high winds swept the Louisiana coast prior to Claudette's landfall. A CHURN station at Cameron, La., reported winds of 45 to 55 kn, but these are regarded as unreliable. Port Arthur also had the lowest recorded pressure of 998 mb. An unconfirmed pressure of 992 mb was re-

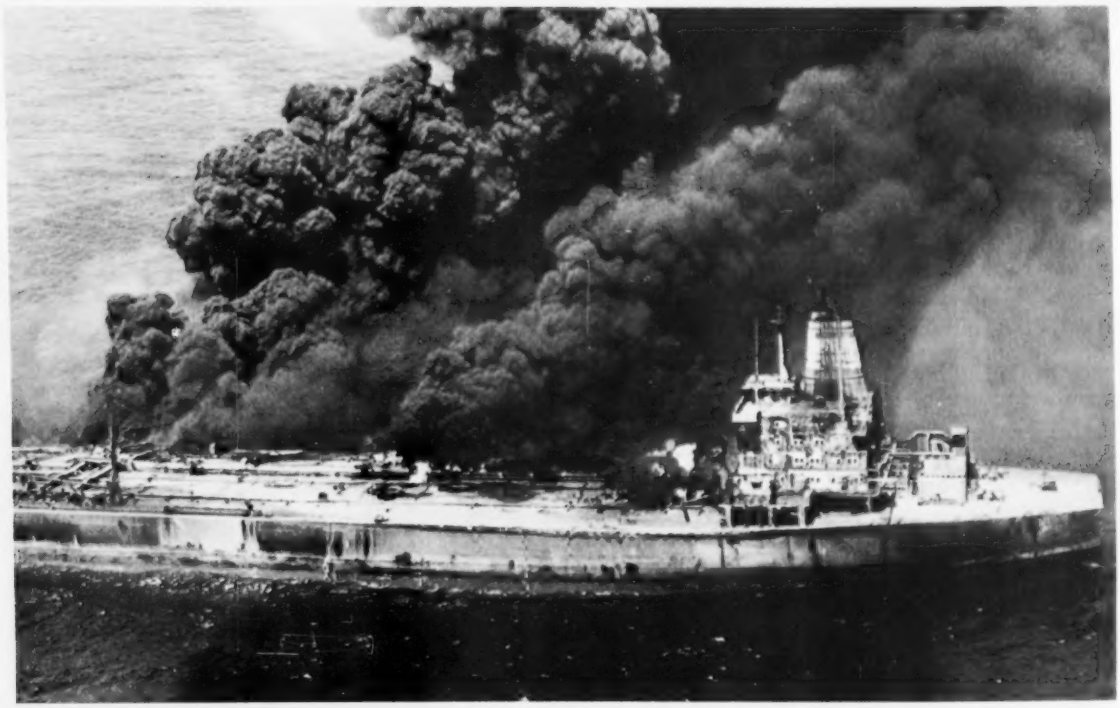


Figure 77.--The VLCC tanker ATLANTIC EMPRESS was burning out of control on the 21st off the coast of Tobago. She finally sank on August 2, becoming the largest vessel and the largest cargo on one vessel to ever be lost. Wide World Photo.

ported at Bridge City, Tex. The lowest estimated pressure before or during landfall was 986 mb. The highest tide was 4 ft MSL at Lake Charles, La., with an estimated 4.5 ft MSL at Sabine Pass, Tex. Rainfall was extremely heavy with serious flooding in southeastern Texas. Southwestern Louisiana also had heavy rain with over 9 in in 57 hr in the Lake Charles area, but no flooding problems resulted there.

No deaths or injuries occurred while Claudette was offshore or moving inland. In Louisiana the impact of Claudette was mainly confined to the immediate coast. Eight miles of LA 82 were badly damaged or destroyed by roadbed washout from tidal action, and about 14 mi of secondary roads were damaged in Cameron parish. Seven homes or fishing camps were destroyed or heavily damaged by winds and waves in Johnsons Bayou near the point of landfall. A mile-long section of beach was eroded back 40 ft in Constance Beach. A number of mobile homes were overturned in Oak Grove. Several boats were sunk at their moorings along the beach. There was minor coastal flooding in communities on coastal bays and bayous as far east as Jefferson parish due to the prolonged southerly flow into Claudette. One station in Sabine Pass, Tex., suffered major roof damage. Otherwise, most of the damage other than flooding in Texas and Louisiana was primarily minor roof damage and downed trees and powerlines. Damage estimates in Louisiana were placed at $300,000 to $400,000

Casualties--The 1,585-ton STAR EXPRESS sustained heavy-weather damage July 1 and 2 near 14.5°N, 71.6°W. The British GEFION sank about 20 mi off St. Lucia, allegedly during heavy weather on the 13th. The 7,952-ton DOVER castle reported at Marseilles on the 13th with weather damage. The new drilling platform GLOMAR JACKUP 1 lost its heliport in heavy weather while being towed from Quebec to Galveston.

Two fully laden very large crude carriers, the Liberian AEGEAN CAPTAIN (210,000 tons) and Greek ATLANTIC EMPRESS (292,000 tons), collided in rain and fog 18 mi off Tobago the night of the 19th (figs. 77 and 78). Twenty-six crewmen from the ATLANTIC EMPRESS and one from the AEGEAN CAPTAIN were missing. Both vessels caught fire. Fire aboard the AEGEAN CAPTAIN was extinguished, but the fire on the ATLANTIC EMPRESS was never controlled--she finally sank on August 2.

The American yacht HAUPT SACHE went aground near Porto Ercole, Italy, during gales. The 110-ton Moroccan ASSFA sank in fog 4 mi off Agader on the 22d. Only 2 crewmen of 11 survived. The British deck barge EL TORITO was beached near Hunting Cay following heavy weather. The 18,736-ton Liberian ore carrier VIDA's engine stopped in fog near the Orkney Islands. Twenty-six crewmen abandoned ship and were rescued by the B.P. SPRINGER. The vessel was taken in tow. The 2,646-ton crane/diving mother vessel PACIFIC INSTALLER lost two anchor buoys and one anchor in heavy weather.

Figure.--78.--The tug is pulling the VLCC tanker AEGEAN CAPTAIN away from the burning ATLANTIC EMPRESS after her fire had been extinguished. Oil was still leaking from her damaged bow. Wide World Photo.

Other Casualties--The 3,000-ton Brazilian MANSUR SIMAO sank in heavy weather 70 mi north of the Rio Grande Bar on the 3d. The 7,282-ton SAFOCEAN AUCKLAND slipped starboard anchor plus 10 shackles of cable plus damage to windlass and motor during heavy weather at Port Elizabeth Roads on the 21st. The 8,576-ton Greek AIFANOURIS shipped water in cracked hatch during heavy weather. The Singapore 6,336-ton TONG NAM broke in half in heavy seas 30 mi northeast of Durban during 30-ft waves and gale-force winds. Six of 38 crewmen were rescued. The master apparently attempted to turn the vessel in extremely heavy weather to return to Durban.

Rough Log, North Pacific Weather

June and July 1979

ROUGH LOG, JUNE 1979--The storms tracked north and west of their climatological paths this month. The primary track was eastward across Hokkaido and then northeastward toward the Bering Sea. There was a secondary track from south of Adak Island to the Alaska Peninsula. The LOWs that reached the North American west coast originated over and south of the Gulf of Alaska. The climatological pattern shows the paths from the southern coast of Japan to near mid-ocean and then split toward the Bering Sea and into the Gulf of Alaska.

The mean sea-level pressure pattern gives an indication of the shift in the storm pattern (fig. 79). The Aleutian Low at 1006 mb was shifted to the Kamchatka Peninsula from north of Atka Island at 1010 mb. The Pacific High was much stronger than normal at 1031 mb versus 1024 mb, and it was also shifted westward to 40°N, 160°W, from 34°N, 145°W. There was a 1018-mb HIGH north of Bering Strait.

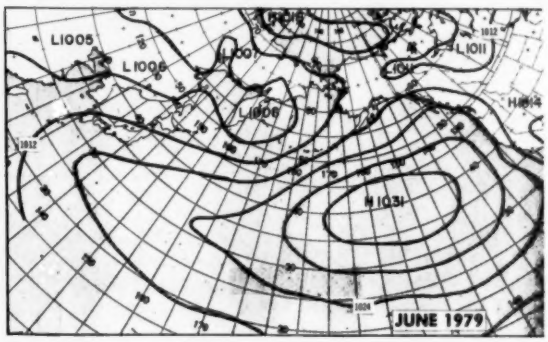


Figure 79.--Mean sea-level pressure, North Pacific,. June 1979.

There were two significant anomaly centers. The largest was plus 13 mb near 43°N, 165°W, with its area of positive values covering most of the ocean to the north of latitude 20°N, except the northwestern corner. A minus 6-mb center was over the Kamchatka Peninsula. The zero isoline was an arc about the center with a radius of 700 to 800 mi.

The upper air pattern at 700 mb revealed the LOW was shifted westward to slightly east of the Kamchatka Peninsula in alinement with the surface LOW. The HIGH centered on 30°N was more intense than normal, and its maximum height also shifted westward. The anomalies were closely alined with their surface counterparts. The plus 117 m was near 44°N, 165°W, and the negative 48 m over central Kamchatka.

Tropical storm Blanca formed over the eastern ocean.

Extratropical Cyclones--The first third of the month the Pacific High was split into two centers, and LOWs and frontal waves were able to develop, especially to the north. The second third of the month the Pacific High was fully developed, averaging about 1040 mb between 40° and 45°N and 150° and 160°W. It reached a maximum pressure of 1043 mb. Lows were kept well to the western and northwestern area of the basin. The last week of the month the High started breaking down, and a LOW moved to the Alaska Peninsula, as another formed off the North American coast and moved ashore near the Strait of Juan de Fuca. Storms that did form were weak even for a spring-summer month. Mostly they were noted for swell waves.

On the 6th a small LOW was analyzed over the Gulf of Alaska. Its lifespan was about 12 hr. The Pacific High was pushing northward, and the MOBIL MERIDIAN near 51°N, 130°W, had 52-kn westerly winds. The High continued to push northeastward, and late on the 7th there were high-wind reports off the northern California coast (fig. 80). The EXXON PHILADELPHIA, JOHN TYLER, and PACIFIC BEAR were among ships in the area. They reported 40- to 45-kn winds, seas up to 20 ft, and swells up to 30 ft. Gales continued through the 8th, but on the 9th a trough from the Mexican heat LOW relaxed and, therefore, so did the gradient.

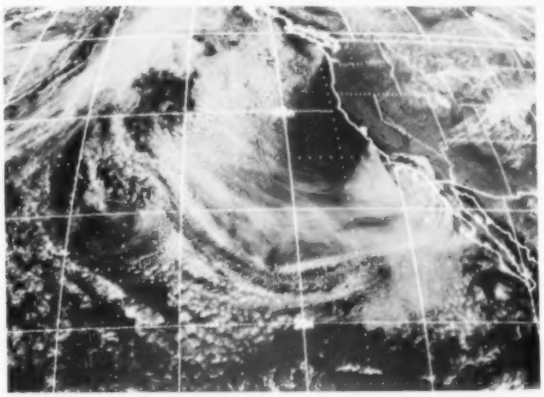


Figure 80.--Fog and stratus hug the southern California coast, while strong northerly winds blow along the clear northern California coast.

The first significant storm of the month came out of the Sea of Japan on the 8th. On the 9th it was bringing gales to the area around 40°N, 155°E. At 1200 the 990-mb LOW was near 46°N, 163°E. On the 10th a ship in the southerly flow reported gales with 16-ft seas and 20-ft swells.

The storm was now pushing against the developing Pacific High and reverted to a frontal wave and raced into the Bering Sea. Another LOW had formed at the point of occlusion and tried the southerly route around the HIGH for 24 hr, but it gave up on the 12th.

This storm also formed over the Sea of Japan on the 10th. On the 13th the 992-mb LOW was near 49°N, 158°E. The MYS KOURILSKII was east of Ostrop Urup with 37-kn westerly winds, while the island measured 35 kn. On the 14th a ship slightly farther east had 21-

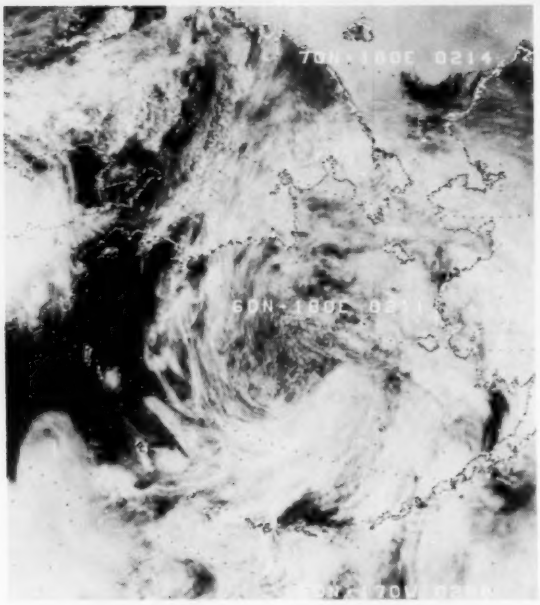


Figure 81.--The storm covers all but the western part of the Bering Sea. Ice still hugs the Arctic coasts, except in the Chukchi Sea.

ft swell waves. By the 16th the storm was well into the Bering Sea with a relatively large but weak circulation (fig. 81). The HOHSING BREEZE was near Saint Paul Island with 39-kn winds and 20-ft seas and swells. On the 17th the storm was blowing out north of the Pribilof Islands, and a ship near the Rat Islands had 16-ft waves out of the southwest.

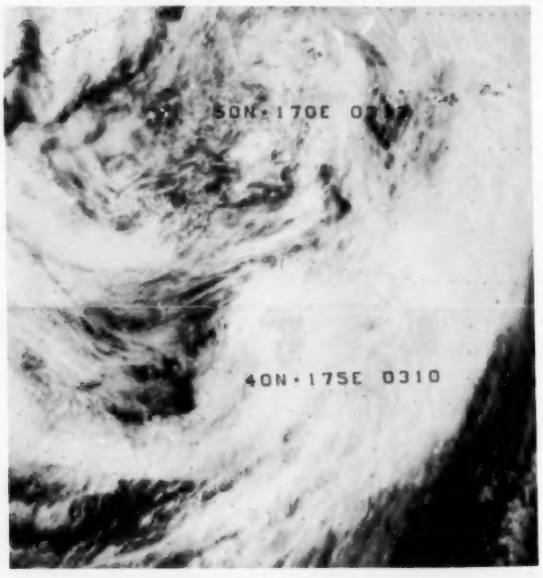


Figure 82.--It is difficult to determine the center of the storm from the cloud pattern as the low and high clouds blend together.

The Kamchatka Peninsula was the birthplace of this low-pressure center. It moved northward the first 12 hr of the 20th, then southward for 12 hr. On the 22d the PRESIDENT KENNEDY was far south of the center along the front with 35-kn winds. The LUCID STAR was a few hundred miles east near 41°N, 179°W, with 39-kn southerly winds. The 5-ft waves they were reporting did match the windspeed very well. The CORAL ACE had showers of hail on the 23d with 18-ft swell waves.

The area north of Mongolia produced this LOW. It crossed the Sea of Okhotsk on the 23d. At 1200 of the 24th the 992-mb storm was near 47°N, 155°E. The BEISHU MARU was about 250 mi south of the center with 21-ft swell waves. On the 25th two ships near 51°N, 158°E, reported gales of 35 to 40 kn. The GOLDEN ORCHID found 40-kn winds east of the front near 45°N, 172°E, with 16-ft waves on the 26th. She was traveling northeastward at about the same speed as the weather system and on the 27th had 48-kn southerly winds very near the front (fig. 82). On the 28th a series of frontal waves moved eastward south of the weakening center, and it dissipated.

Monster of the Month--This was one of those frontal waves mentioned above. The wave that became this storm was indicated on the 0000 analysis of the 28th. By 0000 on the 29th it was south of Amchitka Island in the Aleutians. Both the MAPLE ACE (48°N,176°W) and the SHIMA MARU (45°N, 177°W) were east of the front with southerly gales between 35 and 40 kn. Both were reporting 13-ft waves.

Another frontal wave was following this one, and the ZENKOREN MARU found 16-ft swell waves south of it. This frontal wave was moving around the periphery of the larger one. The NEPTUNE TOPAZ at 40°N, 175°W, was south of both centers at 0000 on the 30th with 45-kn winds from the southeast and 30-ft swell waves from the southwest. At 0600 her winds had relaxed to 40 kn and the waves to 20 ft. A Japanese ship at 44°N, 171°W, had picked up the 45-kn winds.

The storm turned westward, then northward, and died over the Bering Sea.

Continuing frontal waves on the east-west-oriented front brought torrential rains to Japan for 5 days prior to July 1 (fig. 83). At least 23 people died, with 5 missing, 50 injured, and 28,000 left homeless in the downpour. The Meteorological Agency said that up to 1,200 mm (47 in) fell in mountainous areas of southern Japan. The heavy rains triggered 1,700 landslides, washed out 28 bridges, and rivers broke their banks in 70 places.

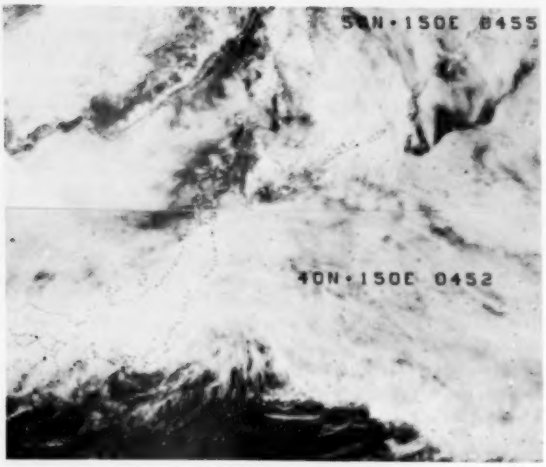


Figure 83.--The frontal waves that brought drenching rains to Japan are buried in this massive cloud shield.

Tropical Cyclones, Eastern Pacific--Tropical storm Blanca developed on the 20th, becoming the second named tropical cyclone. Blanca moved west-northwestward along the 10th parallel, passing south of Clipperton Island on the 22d. Her winds were at a maximum of 45 kn at this time. By the 24th she had crossed the 115th meridian and was starting to weaken. The following day she fell to depression strength.

Casualties--The 42,446-ton Liberian-registered ALCYONE was at Kobe on the 5th with heavy-weather damage. The 6,186-ton Canadian icebreaker JOHN A. MACDONALD commenced breaking out of Summers Harbor (70°N, 125°W) on the 6th. First-year ice was ten tenths, 6 to 9 ft thick, with ridges 24 ft thick. She received heavy ice damage and propeller damage on the 28th. Temporary repairs were made at Tuktoyaktuk.

The following casualties occurred in the Indian and South Pacific Oceans. The 14,412-ton PACDUCHESS sustained damage when containers shifted in heavy weather between Melbourne and Adelaide on the 17th and 18th. Barges from the Russian barge carrier JULIUS FUCIK broke loose in Bombay Harbor during heavy weather and contacted the EFFIGYNY. On the 27th the GULF PEARL (1,831 tons) returned to Bombay with water damage to hatches from heavy weather that day. The 15,409-ton Liberian AVILES broke in half, exploded, and sank 400 mi off the southwestern coast of India. The ESSO SCOTIA engaged in rescuing survivors. The weather during the rescue was winds northerly force 7, seas rough 8 to 13 ft, and swells of 25 ft. The Indonesian cargo vessel ASAHAN (8,661 tons) put into Bombay for heavy-weather damage. The 150,000-ton Liberian tanker BRAZILIAN PEACE alleged heavy-weather damage June 12 to 14 on a voyage Kharg Island to Sao Sebastiao.

ROUGH LOG, JULY 1979--The storms this month had a poor sense of direction. The paths wandered and curved back from their original direction. The primary storm path stretched from Honshu eastward to near midocean and then northeastward into the western Gulf of Alaska. Another track would be from the vicinity of the Date Line and 40°N curving into the Gulf of Alaska. The center of none of the LOWs was able to penetrate inland on the North American coast. One long-lived LOW tracked from China on the 12th to the East Siberian Sea on the 26th.

The climatological monthly normal sea-level pressure pattern for the North Pacific basin indicates only the large Pacific High (fig. 84). Slight troughing is indicated over the Bering Sea. This month's mean showed the 1025-mb Pacific High centered near 34°N,145°W. A 1014-mb LOW is indicated over the Gulf of Alaska and another 1008-mb LOW over eastern Siberia.

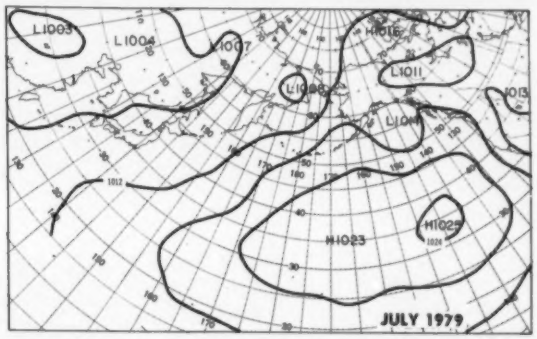


Figure 84.--Mean sea-level pressure, North Pacific, July 1979.

A positive 3-mb anomaly center near the Pribilof Islands split negative values on both sides north of latitude 30°N. The western part was only very slightly negative. The eastern part had a minus 4-mb center near 51°N, 143°W.

The upper-air pattern at 700 mb showed the usual HIGH centered around 30°N and the Date Line. In climatology there is only one LOW centered over the North Pole, but this month there were also two anomalous LOWs, one over the Gulf of Alaska and the other over the Sea of Okhotsk. The troughs off the Asian and North American coasts were more pronounced than in climatology.

There were six tropical cyclones named over the North Pacific, four over the western ocean and two over the eastern ocean. They were typhoons Ellis and Hope and tropical storms Faye and Gordon in the western ocean, and tropical storm Carlos and hurricane Dolores in the eastern ocean.

Extratropical Cyclones--The first week of the month the Pacific High moved westward to near 40°N, 165°W. This allowed the development and intrusion of several LOWs off the United States-Canadian coast. During the second week the HIGH weakened and split into two centers. By the third week it had rejuvenated and was again off the West Coast. During the fourth week it spread westward again, and by the end of the month it was centered near 40°N, 175°W.

The first storm originated as a frontal wave over the Sea of Japan on the 1st. On the 2d a ship reported 13-ft waves well south of the storm's center. By 1200 on the 3d the storm was centered over Ostrov Simushir at 987 mb. The SHUWA MARU was east of the warm front near 44°N, 164°E, with 42-kn southerly winds and 15-ft swell waves. Another Japanese ship 700 mi south

of the center had 16-ft waves. On the 4th several ships reported winds near 40 kn and waves of about 15 ft. The highest was again near the warm front (48°N, 166°E) by the ALASKA MARU with 45 kn and 16 ft. The HOHSING ARROW found 25-ft swells near 52°N, 169°E. Gales continued through the 5th (fig. 85) as the storm traveled along the Asian coast, gradually weakening to dissipate on the 6th. Saint Paul Island received winds up to 35 mi/h.

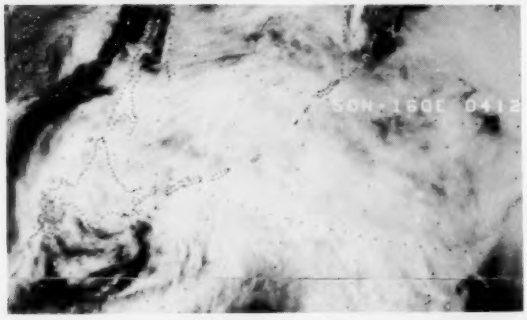


Figure 85.--The storm is buried under the clouds near Ostrov Iturup. Note the difference in the structure of these clouds and the stratus type to the northeast.

As the Pacific High moved westward, a low-pressure area developed off the coast of northern California. A series of LOWs formed and dissipated during the next week, some lasting only a matter of hours. One of these was first noticed on the 0000 chart of the 8th. Another LOW was moving southward from the Gulf of Alaska. At 0000 on the 9th the southern storm was the primary system at 997 mb near 44°N, 137°W. A ship near 37°N, 133°W, had 16-ft swell waves. A British ship near 36°N, 128°W, headed for San Francisco, also had 16-ft waves at 1200. At 1800 a SHIP near 42°N, 125°W, was sailing south into 35-kn winds, 16-ft seas, and 30-ft swells (fig. 86). Winds gusted to 76 kn at

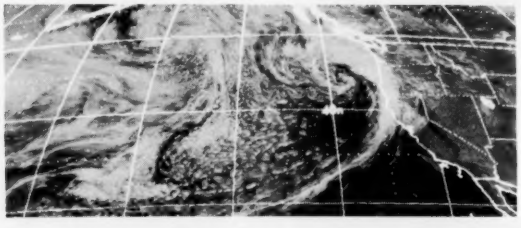


Figure 86.--At this time on the 9th there were two cyclones, one off the Oregon coast and the other off the Queen Charlotte Islands.

Priest Rapids Dam in Washington. Late on the 10th this LOW disappeared off the Queen Charlotte Islands, and another developed farther north.

The Pacific High was split into two centers on the 9th over the central ocean. One was over the Bering Sea and the other near 40°N, 170°W. The southern center dropped over 400 mi southward in 12 hr, and a warm front was analyzed between the two HIGHs. On the 10th a wave developed on the warm front. The PRESIDENT TAFT was near the wave with 13-ft waves. On the 11th the TOHBEI MARU had 16-ft swells west of the 997-mb center, which was now near 44°N, 167°W. The KATO in the southwest quadrant had 35-kn gales. At this time this was a relatively small storm, but as it turned southward the circulation expanded and the gradient relaxed even further. At 0600 on the 12th the 9VAJ reported 35-kn southerly winds east of the center. This was the last report approaching gale force prior to the storm's demise on the 14th.

This storm had its beginning over China. It crossed northern Honshu late on the 11th. At 1200 on the 13th the 996-mb storm was near 38°N, 152°E, and the PRESIDENT MADISON was west of the center at 38°N, 147°E, with 21-ft swell waves from the north. By midday on the 14th the storm had reverted back to a frontal wave; it disintegrated on the 16th.

This long-lived storm came out of central China. It survived for many days as only an identifiable frontal wave. On the 15th it passed south of Tokyo. The HAKUHO MARU was southeast of the wave with a thunderstorm and 50-kn winds. On the 16th the storm had a large-scale circulation. On the 17th the ELBE EXPRESS was south of the 996-mb center with 13-ft waves. The storm was now traveling northward. During the 18th the storm turned eastward again and moved over the Bering Sea. On the 20th the storm was 992 mb at 59°N, 175°E. The OJI GLORIA (50°N, 166°E) found 42-kn winds, and the TOYOTA MARU (51°N, 176°E) had 35-kn winds and 16-ft waves. On the 21st two ships as far as 600 mi south of the center were in 13-ft swells from this storm. The storm dawdled over the northern Bering Sea until the 25th, when it suddenly raced across the Chukchi Peninsula and into the East Siberian Sea.

On the 11th the Pacific High started moving northward and building. This in conjunction with intensification of the heat LOW over southern California and its trough into northern California greatly increased the pressure gradient off the northern California coast. Ships began reporting northerly gales in that area. On the 13th an Italian ship (38°N, 124°W) had 40-kn winds and 15-ft waves. The PRESIDENT TRUMAN had 35 kn and 16-ft waves. On the 14th the ARCO JUNEAU found 35-kn winds. On the 15th it was the AMERICAN LEGION's turn with 38-kn winds near 35°N, 127°W. The gradient relaxed on the 16th.

This storm came out of the central ocean between 40° and 45°N south of the Fox Islands on the 17th. On the 19th the storm intensified. At 1800 the SAMUEL CHASE (46°N, 145°W) was 200 mi east of the 1007-mb center with 40-kn southwesterly winds. On the 20th the ORIENTAL MERCHANT and PACIFIC VENTURE had near gale-force winds and swells to 20 ft. OWS Papa had 35-kn gales. The storm dissipated on the 21st as it approached the southern coast of Alaska. The Pacific High moved back in, and isolated northerly gales again occurred along the northern California coast.

Monster of the Month--This LOW formed in a col area left behind as a series of frontal waves moved eastward between 35° and 40°N latitude. The 0000 chart of the 25th showed the LOW near 43°N, 170°E. The Japanese JKCQ had 35-kn gales near 38°N, 173°E. The

RIVER ROSE was 1.5 mb north of the 996-mb center on the 26th with 39-kn easterly winds. Another ship had 38-kn winds from the north near 49°N, 177°E.

The storm moved along the Aleutian Islands on the 26th and 27th. The ship JLJL had been following the storm on its northeasterly track, and at 1800 on the 27th had 35-kn winds about 300 mi southwest of the center. The waves were 16 ft. On the 28th a ship at 41°N, 159°W, reported 48-kn northwesterly winds to the north of the cold front (fig. 87). The storm now turned southeastward. At 0000 on the 29th it was 1002 mb near 50°N, 149°W. Two ships northeast of the center reported the highest winds, both out of the northeast. One had 37 kn and the other, near 51°N, 144°W, had 58 kn. At 1800 the CHEVRON HAWAII (54°N, 140°W) had 41-kn southeasterlies. The seas had been relatively calm in comparison to some of the winds reported. This trend was broken by the SANKOSTAR on the 30th by her report from 43°N, 157°W, of 40-kn winds, 26-ft seas, and 30-ft swells. On the 31st this LOW disappeared as another formed farther north in the Gulf. This second LOW dissipated as it touched the coast.

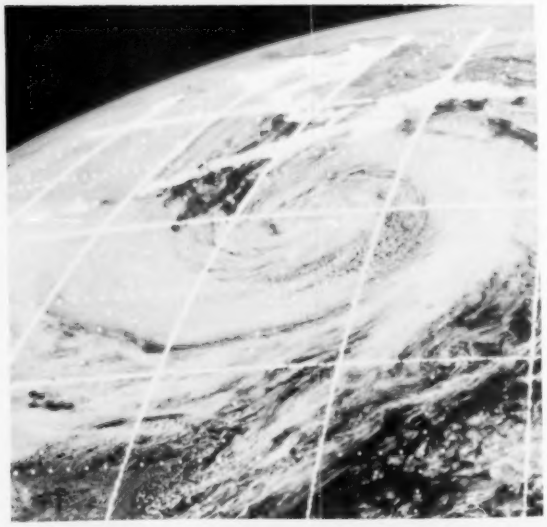


Figure 87.--The storm looks like a giant pinwheel from this angle. Although not an exceptionally deep severe storm, it covered a large area.

Tropical Cyclones, Eastern Pacific--Carlos, a short-lived tropical storm, came to life on the 14th about 100 mi south of Manzanillo. Winds near his westward-moving center climbed to 45 kn on the 15th. However, as Carlos approached Socorro Island on the 16th, he became impotent.

Dolores developed some 300 mi east of Clipperton Island on the 17th. She moved west-northwestward and intensified. Late on the 18th Dolores was a hurricane on a northwesterly course. She crossed the 15th parallel on the 20th near 118°W. She was generating winds up to 90 kn at the time. The following day her winds peaked at 105 kn (fig. 88). The northwesterly course became her downfall. She crossed the 20th parallel at about 0000 on the 22d as a tropical storm, and the 25th parallel near 125°W on the 23d as a tropical depression.

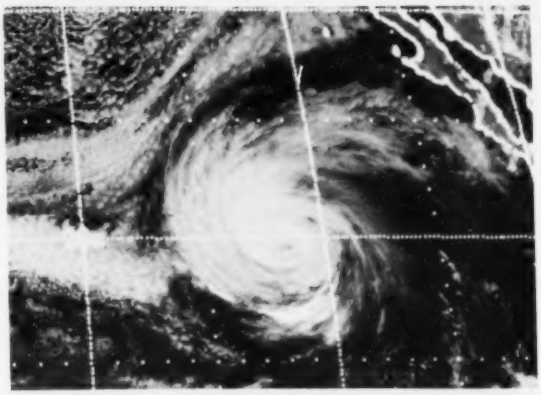


Figure 88.--Hurricane Dolores is a powerful storm. Luckily, at this time she was away from land and the major shipping lanes.

Tropical Cyclones, Western Pacific--Typhoon Ellis formed in the central Philippine Sea around the 1st of the month. He moved toward the west-northwest and reached typhoon strength late on the 2d (fig. 89). Maximum winds climbed to 85 kn before he moved ashore, across northern Luzon, on the 3d. In Manila Bay 990 Vietnamese refugees from the TUNG AN were transferred to a Navy ship for safety. Ellis continued west-northwestward as a tropical storm. He crossed the South China Sea and moved inland southwest of Hong Kong on the 6th.

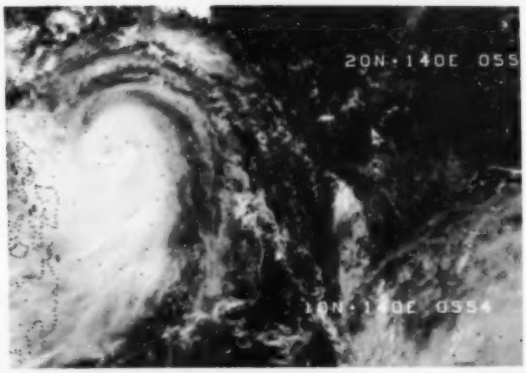


Figure 89.--Typhoon Ellis at tropical-storm strength early on the 2d. He formed and intensified very quickly.

Faye had a similar lifespan. She began near Truk and ended just north of where Ellis came to life. Faye was a tropical storm at best, from the 3d through the 5th. Maximum winds reached 55 kn on the 5th, just after she breezed by Ulithi and Yap and just before she recurved northward.

Tropical storm Gordon had the honor of acting as a harbinger of the destruction to be visited upon Hong Kong less than a week later. Gordon formed on the 26th near 20°N, 130°E. His west-northwestward course took him through the Luzon Strait and eventually onto the China mainland about 150 mi east-northeast of

Hong Kong. Maximum winds reached 55 kn on the 28th, the day before Gordon went aground (fig. 90).

Meanwhile, south of Guam a depression had formed, dissipated, and regenerated. Hope was christened on the 29th near 17°N, 135°E. Her course was west-northwestward. She was a typhoon that same day. Her winds climbed to 75 kn on the 30th, 100 kn on the 31st, and to 130 kn by the 1st. The supertyphoon was on a collision course with Hong Kong (fig. 91). As she approached land maximum winds dropped to around 100 kn. Hope, an unsuited name as there ever was, came ashore over the colony on the 2d of August. She caused havoc in the harbor. Some 17 ships dragged anchor and another 10 broke free and collided. The ARGONAUT, a Greek cargo carrier, crashed into the Star Ferry Terminal and wedged itself into the seawall. The 6,300-ton LAMMA ISLAND ran aground as did the refugee ship HUEY FONG. Other refugees, some 500 people, were feared lost in the South China Sea after being turned away from Macao by Portuguese authorities. The refugees were running for Hong Kong in a junk and two flimsy fishing boats.

The typhoon is the worst to hit the colony since Rose in 1971, when 100 people were killed. Early reports indicate 12 deaths in Hong Kong; six people had already been killed on Taiwan and the Philippines. Damage is estimated in the millions of dollars. About 270 cylinders, each containing about 40 oz of cyanide salt, were washed off a government dockyard by waves during the storm. At last report 123 of the cylinders of the deadly chemical had been recovered.

Hope moved westward across southern China and into Vietnam before dissipating.

Casualties--The 4,009-ton Panamanian HAI HYUN grounded on Apo Reef (12.6°N, 120.5°E) on the 27th. The crew evacuated to an island due to water in the engineroom and rough weather. Wave action was causing the vessel to shake and vibrate. The wind was force 8 to 10 with heavy rain and very rough seas.

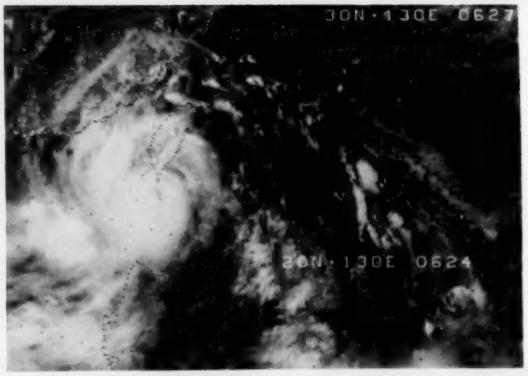


Figure 90.--Tropical storm Gordon was south of Taiwan early on the 28th.

The crew was picked up by the ORIENTAL EXPERT.

Casualties in the Pacific and Indian Oceans. The 13,819-ton Indian KAIRALI was overdue on July 3 in the Indian Ocean. The weather in that area was 30- to 40-kn west-southwesterly winds in squalls and 13- to 20-ft very rough seas. The British IRON ENDEAVOUR sustained heavy-weather damage on a voyage Port Hedland to Fremantle. The 1,925-ton Indian NANDA DEVI sank at anchor off Karachi when she was swamped by heavy seas. The 7,786-ton British NEW ZEALAND STAR suffered damage to batteries when sea water entered the ventilation pipes during heavy weather from Melbourne to Fremantle. The 5,363-ton ARAB ALHIJAZ reported heavy-weather damage on a voyage from the Persian Gulf to India. The Chilean hopper barge ANGUILA moored near Talcahuano, Chile, was hit by a heavy storm on the 25th. She dragged and ran ashore after her moorings were cut.

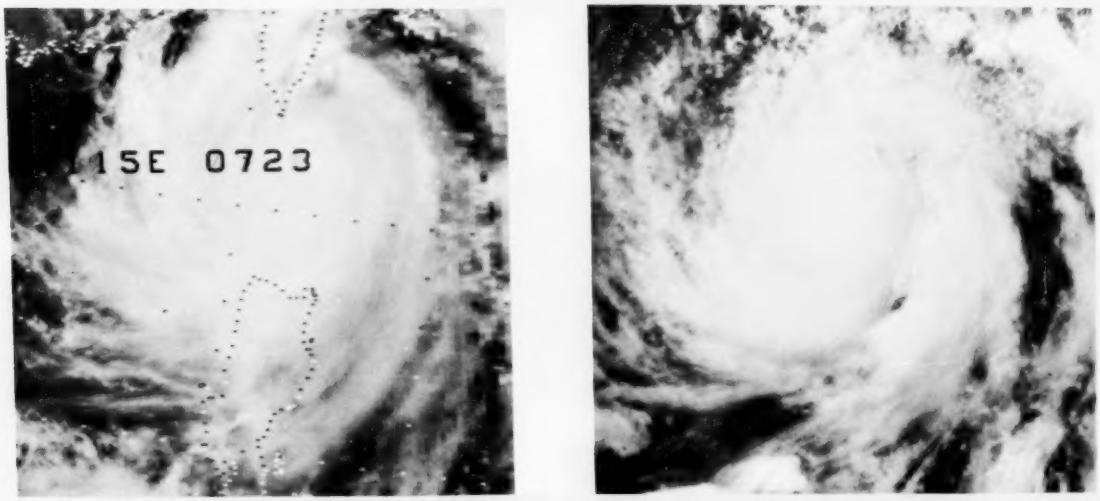


Figure 91.--Typhoon Hope reached supertyphoon strength of 130 kn on August 1 south of Taiwan (left) and hit Hong Kong the next day with winds near 100 kn.

Marine Weather Diary

NORTH ATLANTIC, OCTOBER

WEATHER. Storms in the middle and higher latitudes increase in frequency and energy during October. The westerlies have pushed southward, and the 1002-mb Icelandic Low, centered about midway between Iceland and southern Greenland, is deeper and larger than it was in September. The Azores High, centered near 34°N, 35°W, is only slightly weaker (at 1020 mb) than in the preceding month, but it has diminished in size.

WINDS. North of 40°N, the prevailing winds are westerly and generally of force 4 to 6 north of 50°N, and force 3 to 5 between 40° and 50°N. The exceptions are: southerly over the Norwegian Sea, southwesterly over the North Sea, Baltic Sea, and adjacent waters, variable near the Icelandic Low, and light (force-2) northwesterlies through north- to southeasterlies around the Davis Strait. South of 40°N, northeasterly winds prevail of force 3 to 4. Southeasterly force-3 winds blow near the Equator between South America and Africa. Northwesterly winds of force 2 to 3 are prevalent over the Mediterranean Sea.

GALES. Both the frequency of and the area subject to gales increase markedly over the previous few months. Winds of force 8 or more can be expected oceanwide north of about 40°N, with a frequency from 5 to over 20 percent. The highest frequencies occur over a small area south of Greenland's southern tip, the Greenland Sea, and the northern portion of the Norwegian Sea. An analysis of eight Ocean Station Vessels north of 40°N indicates that gales generally last less than 1 day over these waters.

EXTRATROPICAL CYCLONES. The temperature contrast off the Atlantic coast, from Labrador through the Carolinas, is conducive to cyclogenesis. Other principal areas of cyclogenesis lie over midocean within an egg-shaped area oriented in a northeast-southwest fashion and comprising a 250- to 300-mi-wide area between 56°N, 23°W, and 48°N, 37°W; over the Bay of Biscay; within the coastal area from Marseilles east-southeastward to Naples; over all but the extreme southern part of the Adriatic Sea; over the Skagerrak, the Kattegat, and the Baltic Sea to about 61°N; off the northern Norwegian coast; east of Iceland; and off the Denmark Strait coast of Greenland. There are more extratropical cyclones than in September, but primary storm tracks are similar, although most are displaced a little farther south. The secondary cyclone track over the northwestern Mediterranean area has lengthened and become of primary importance. Primary tracks are also found over North America from Kansas across the Great Lakes to James Bay, and from James Bay to the Labrador coast. From the Newfoundland-Labrador coasts, the main track is toward Iceland. Another shorter track exists, about 5° latitude south of the main track in midocean. A single track extends from south of Iceland to northern Norway. Occasionally, North Atlantic extratropical storms, being of considerable intensity, generate hurricane- or near-hurricane-force winds.

TROPICAL CYCLONES. The hurricane season continues into October, but after the middle of the month, the probability of a tropical storm occurrence diminishes rapidly. An average of 3 to 4 tropical storms will occur each 2 yr, and about half will develop to hurricane strength. The vast majority of the storms develop before the 21st of the month. Most October storms form over the western Caribbean, but some are spawned near the Lesser Antilles.

SEA HEIGHTS. During October, sea heights of 12 ft or more are usually encountered 10 percent or more of the time over the open ocean north of about 40°N (excluding most of the Norwegian Sea), over the Gulf of Lions, and over central Hudson Bay. An area of 20-percent frequency extends southward out of the Denmark Strait, then eastward south of Iceland to the Faeroe Islands, and westward around Kap Farvel into the Labrador Sea. The southernmost point of the southern boundary is about 57°N, near 35°W. A second small area, about 4° in diameter, is centered near 50°N, 40°W. The areas described above very closely approximate the 10-percent frequency for waves of 20 ft or greater.

VISIBILITY continues to improve during October, compared with the previous month. Frequencies of 10 percent or more of visibility less than 2 mi are now found in only three scattered areas--the southern Davis Strait and northern Labrador Sea, over waters due east of Newfoundland, and from the southern reaches of the Denmark Strait southeastward to the Faeroe Islands and then north-northeastward to the Greenland Sea. As in September, the cold waters north of Iceland entertain an area of 20- to 30-percent frequency of visibility less than 2 mi, and a small area (within this larger area and centered near 68°N, 18°W) where visibility less than 2 mi exceeds 30 percent of all observations.

NORTH PACIFIC, OCTOBER

WEATHER. October marks the transition to winter conditions over the northern latitudes of the North Pacific. The Aleutian Low, lying off Cape Newenham, Alaska, has deepened 4.5 mb (as compared to September) to 1002.5 mb, while the subtropical High has become a flat east-west ridge, centered roughly along the 33d parallel, containing a maximum pressure of about 1020 mb.

WINDS. Between 40° and 60°N, westerly winds predominate, with forces 4 to 6 most frequent. However, northwesterlies and northerlies prevail over the eastern Bering Sea, easterlies dominate the Gulf of Alaska, and winds off the coast of British Columbia normally blow from the southwesterly quarter. North of 60°N, the winds are northerly to northeasterly at force 3 to 5. From 30° to 40°N, directions are more variable, with northeasterly and northerly winds prevalent east of Honshu, and northwesterlies common east of the dateline, shifting to northerly near the California coast. Force-4 winds constitute the largest percent-

age frequency within the above latitudinal belt. The northeast trades, which average slightly less than force 4, prevail between the Equator and 30°N. Northerly force-3 winds are the general rule out from the Gulf of Tehuantepec. The winter monsoon is now well established over Asiatic waters, penetrating as far south as Indochina.

GALES. The chances of encountering winds of force 8 or higher increase appreciably in October, particularly in the middle and higher latitudes. The highest incidence of gales occurs between 48° and 56°N, from Kamchatka eastward to about 140°W, with over 10 percent of the wind observations over most of these waters revealing gales. Ships plying the central Bering Sea as far north as the 63d parallel are also laced by gale-force winds more than 10 percent of the time. There is a gradual decrease in frequency southward--gales are infrequent south of 30°N over the central ocean, 35°N over the western ocean, and about 44°N above eastern waters. Nevertheless, gales are observed between 5 and 10 percent of the time over the typhoon-troubled waters near Taiwan, and those southwest of Japan.

EXTRATROPICAL CYCLONES. The frequency and intensity of extratropical cyclones increase in October. The principal sources of storms, or cyclogenesis, are the Mongolia - Manchuria area and the seas south of Japan. Other areas are along the Aleutian Islands, and over the midocean slightly north of latitude 40°N. The primary storm tracks extend from across Sakhalin and south of Japan toward the Near Islands. From there, the track parallels the Aleutian Islands into the Gulf of Alaska. Another track comes out of the midocean source area into the Gulf of Alaska. A secondary track departs the Near Islands for the Bering Strait.

TROPICAL CYCLONES. Three or four tropical cyclones can be expected to develop over the tropical waters of the Far East. On the average, two or three reach typhoon intensity. Most of these tropical cyclones form at low latitudes in an area extending from the Philippine Islands to about 155°E. Their early movement is generally west-northwestward, and most recurve east of the Philippines or Taiwan and sweep up along the east coast of Japan. A smaller number move across the Philippines into the South China Sea; a still smaller number reach the Asiatic mainland.

In the tropical waters of the eastern North Pacific, tropical cyclones are less frequent than in September, averaging about two per year. Roughly half of these storms reach hurricane intensity at some time in their lives. October tropical cyclones follow less regular tracks than those of September. After developing off the coast of southern Mexico-Guatemala, or near the Revillagigedo Islands, a large percentage of these storms will move inland over Mexico, south of about 30°N.

SEA HEIGHTS. The frequency and area of high waves increase, especially over the northern shipping lanes. The area bounded by approximately 43°N, 160°E, 145°W, and the Aleutian Islands, has 12-ft or higher waves over 10 percent of the time. In general, the area from coast to coast between 30° and 55°N will have seas 12 ft or greater, 2 to 10 percent of the time.

VISIBILITY. Percentage frequencies of low visibility decrease in October. Visibility less than 2 mi occurs 10 percent or more of the time north of a line drawn from Ostrov Karaginski eastward to a point northeast of the Pribilofs, and then southwestward across the Fox Islands to a point near 42°N, 175°W. From there, the line extends eastward across the 155th meridian, and then northward to Kodiak Island.

NORTH ATLANTIC, NOVEMBER

WEATHER. While normally November is considered a transitional period between fall and winter weather over northern waters, this month occasionally develops some of the severest weather of the winter season. Most rough weather is confined to north of 45°N, except along the coast of the United States, where there is an increase in winter-type LOWs. Over the Great Lakes Region, two primary storm tracks--of Alberta and Colorado LOWs--converge into an area of maximum cyclone frequency, contributing in a large measure to rough weather toward the close of the Lakes' navigation season. The Icelandic Low (1002 mb) is still centered between Iceland and southern Greenland. The Azores High has shifted eastward and is centered near 33°N, 29°W; its central pressure has risen slightly to about 1021 mb.

WINDS north of 60°N are quite variable at about force 4 to 5, although these winds tend to come from the northerly quarter west of Iceland, and from the southerly quarter east of that island nation. Westerly winds, force 4 to 6, prevail over most of the ocean between 40° and 60°N. Between the latitudes of 30° and 40°N, force 3 to 4 winds are of variable direction, except east of the Azores, where a noticeable northerly component prevails. The northeast trades, averaging force 3 to 4, extend from 30°N southward to 10°N. Between 10°N and the Equator, southeasterlies (force 3) are predominant.

GALES. The frequency of gales over northern and middle latitudes increases substantially in November. Winds of force 8 or higher occur 10 percent or more of the time over most areas north of about 35°N over western waters; north of about 40°N over the central ocean; and north of about 44°N over eastern waters, including the southern half of the North Sea. A 10-percent frequency of gales is encountered on the Mediterranean only over the Gulf of Lions. Frequencies are generally less than 10 percent, however, over the waters between Iceland and southern Greenland (near the center of the Icelandic Low), over a relatively small area about 200 mi northwest of the western Irish coast, and over and south of the Irish Sea. Frequencies of 20 percent or more occur in the Davis Strait north of 63°N, south of Greenland in the vicinity of 55°N, 45°W, and over most of the Greenland and Norwegian Seas.

EXTRATROPICAL CYCLONES. The principal track of extratropical LOWs is northeastward from the waters off Cape Cod, across Newfoundland to Iceland, and then through the Norwegian Sea. Sometimes these

cyclones will approach Iceland from the central part of the North Atlantic Ocean. Other major tracks lead from Hudson Bay to the Davis Strait, and from the Gulf of Lions to Italy.

TROPICAL CYCLONES are infrequent in November. Usually, one storm in 3 yr may be expected, and about half will develop to hurricane intensity. Most of these storms develop over the Caribbean Sea or eastern Gulf of Mexico, and are soon following a northeasterly path out over the main body of the North Atlantic.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time on most of the ocean north of about 40°N and south of the Davis Strait and the Norwegian Sea, and on the Mediterranean Sea in the Gulf of Lions and the northern Aegean Sea. The frequency increases to 20 percent or more over most of the waters between 47° and 60°N, and extending into the Denmark Strait.

VISIBILITY less than 2 mi reaches a frequency of 10 percent north of a line drawn from the waters around, and 200 mi south of, Kap Farvel west-northwestward to Saglik, Labrador (55 mi northwest of Cod Island); and north of another line extending from Angmagssalik, Greenland, to northwestern Iceland, then across land to the Vesturhorn (eastern Iceland), then eastward to 64°N, 07°W; it then stretches north-northeastward across the Norwegian Sea to the waters north of Norway. An area of frequencies exceeding 20 percent or more lies north of Iceland between 67° and 72°N, and westward from 05°W to Greenland.

NORTH PACIFIC, NOVEMBER

WEATHER. November is often a stormy month north of 35°N over western waters, and about 40°N over the eastern ocean. There have been years when November was the stormiest month of the winter season, but generally the weather is not too severe, and there may be quiet periods lasting several days. South of 40°N, the probability of severe extratropical storms diminishes rapidly with latitude. During November, the Aleutian Low, near 57°N, 170°W, is well established over northern latitudes, with a central pressure of 1000 mb. The Pacific subtropical High, at 1021 mb, is slightly stronger than in October and is centered near 33°N, 140°W. Off the Chinese coast, pressures are higher than during October because of the buildup of the cold Asiatic High.

WINDS. Over the ocean north of 55°N, northerly winds (force 4 to 6) prevail, except over the eastern Bering Sea, where winds are variable, and the Gulf of Alaska, where easterlies and northeasterlies are most common. With the exception of the area east of 140°W, where southerly and westerly winds are prevalent, westerly winds (force 4 to 6) predominate between 55° and 35°N. Variable winds near force 4 are most frequent between 35° and 25°N, except over the Yellow Sea and waters off Japan, where northerlies predominate. The northeast monsoon (affecting areas west of 140°E) and the northeast trades blow steadily at about force 4, south of 25°N. Lighter force 2 to 3 winds are the rule over the southern limits of the South China Sea, east of the Gulf of Siam. Northerly winds blow steadily out from the Gulf of Tehuantepec, off Mexico's south coast. They reach gale force between 5 and 10 percent of the time just west of the gulf.

GALES occur 5 percent or more of the time north of about 35°N. An area of 5- to 10-percent frequency is also found over the northern reaches of the South China Sea, including the Formosa Strait and the Luzon Strait, and west of the Gulf fo Tehuantepec, as mentioned above. Actually, a frequency of 10 percent or more is found over most of the waters north of 39°N, with the exception of the eastern Pacific east of 154°W (south of 50°N) and the waters east of the Kamchatka Peninsula. A small area of maximum frequency, where gales occur 20 percent or more of the time, is centered about 225 mi southeast of the southern tip of Kamchatka.

EXTRATROPICAL CYCLONES. The main storm tracks extend northeastward from the Japanese Islands to the western Aleutians, and then east-northeastward to the Gulf of Alaska. Another primary cyclone track enters the gulf from an area in the central ocean near 47°N, 169°W. In November, there are more LOWs passing over the Gulf of Alaska than any other part of the Northern Hemisphere; this is also true of 5 of the following 6 mo.

TROPICAL CYCLONES. On the average, two or three tropical cyclones develop over the western North Pacific in November. Two of these usually reach typhoon intensity. The region of most frequent formation is in the vicinity of the central and western Caroline Islands; the tropical cyclones either travel west-northwestward over the Philippines and the South China Sea, or recurve near 15°N, 132°E, to pass east of the Japanese Islands.

Tropical storm frequency over the eastern North Pacific drops rapidly for November, averaging about one every 3 yr. None have developed to hurricane intensity. Tropical storms very seldom occur in the central North Pacific--maybe one every 20 yr. When these late-season storms do develop in the eastern ocean, their direction of movement is usually more northerly than westerly.

SEA HEIGHTS. The area with 12-ft or greater seas and a frequency of 10 percent is bounded by the Aleutian Islands, 158°E, 43°N to 160°W, where the latitude drops to 35°N, and a line from 35°N, 150°W, to the Queen Charlotte Islands. A small area between Hong Kong and Taiwan is also affected, as is a large part of the Sea of Okhotsk. High-swell observations are found north of 30°N, with a tongue extending to the Equator east of the Hawaiian Islands. These observations are more frequent off the State of Washington coast, south of Kodiak Island, and east of the Kuril Islands.

VISIBILITY. Frequencies of low visibility (less than 2 mi) greater than 10 percent lie north of a line drawn from Mys Terpeniya, Sakhalin, eastward across the central Kurils, and then north-northeastward to the waters east of the Komandorskiye Islands. From there, the line stretches northeastward to St. Lawrence Island and the Seward Peninsula. Two smaller regions of 10-percent or greater frequency are centered over the Bering Sea, near 54°N, 173°W, and over the midlatitudes of the eastern North Pacific, near 46°N, 146°W.

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